like the leopard. This change affects the whole surface of the body, including the eyes and the tail. The animal's movements are very sluggish indeed, like the tortoise. When dying it becomes pale, and it retains this colour when dead. With regard to the position of the oesophagus and the windpipe it resembles the lizards. It has no flesh anywhere except some tiny portions on the head and jaws and the root of the tail. It has blood only round the heart, the eyes, and the region above the heart, and in the small blood-vessels ramifying from them, though even in these parts there is a very small quantity. The brain is situated slightly above the eyes, but is continuous with them. If the outer skin is removed from the eyes, some feature is disclosed which surrounds them and shines through them, like a thin copper ring. Numerous strong membranes extend over practically the whole of the animal's body, far exceeding those present in other animals. It actually goes on functioning with its breath [a] for a long time after being cut open completely, there being still a very slight movement in the breath around the heart, and while contraction takes place particularly round the ribs, it affects the remaining parts of the body as

[a] There is probably an implied reference here to the connate *pneuma* (see *G.A.*, Loeb ed., App. B). At *G.A.* 787 b 15 ff., Aristotle, speaking of the voices of bulls and cows, mentions that the generally sinewy character of bulls applies also to their hearts ; hence, he says, this part with which they set the *pneuma* in movement is taut, like a sinewy string stretched tight. At 787 b 27 he speaks of the blood-vessel which has its starting-point at the heart near to the part which sets the voice in movement. *Cf.* also *G.A.* 776 b 12 ff., 781 a 32 ff., and App. B above cited, especially § 31. Thus it is the heart or the region of the heart which supplies movement to *pneuma* generally in the body.

503 b

ματος. σπλῆνα δ' οὐδαμοῦ ἔχει φανερόν. φωλεύει δὲ καθάπερ οἱ σαῦροι.

XII Ὁμοίως δ' ἔνια μόρια καὶ οἱ ὄρνιθες τοῖς εἰρημένοις ἔχουσι ζῴοις· καὶ γὰρ κεφαλὴν καὶ αὐχένα πάντ' ἔχει καὶ νῶτον καὶ τὰ ὕπτια τοῦ σώματος καὶ τὸ ἀνάλογον τῷ στήθει· σκέλη δὲ δύο καθάπερ ἄνθρωπος μάλιστα τῶν ζῴων· πλὴν κάμπτει εἰς τοὔπισθεν ὁμοίως τοῖς τετράποσιν, ὥσπερ εἴρηται πρότερον. χεῖρας δ' οὐδὲ πόδας προσθίους ἔχει, ἀλλὰ πτέρυγας ἴδιον πρὸς τὰ ἄλλα ζῷα. ἔτι δὲ τὸ ἰσχίον

504 a ὅμοιον μηρῷ μακρὸν καὶ προσπεφυκὸς μέχρι ὑπὸ μέσην τὴν γαστέρα, ὥστε δοκεῖν διαιρούμενον μηρὸν εἶναι, τὸν δὲ μηρὸν μέχρι[1] τῆς κνήμης, ἕτερόν τι μέρος. μεγίστους δὲ τοὺς μηροὺς ἔχει τὰ γαμψώνυχα τῶν ὀρνίθων, καὶ τὸ στῆθος ἰσχυρότερον τῶν ἄλλων. πολυώνυχοι δ' εἰσὶ πάντες οἱ ὄρνιθες, ἔτι δὲ πολυσχιδεῖς τρόπον τινὰ πάντες· τῶν μὲν γὰρ πλείστων διῄρηνται οἱ δάκτυλοι, τὰ δὲ πλωτὰ στεγανόποδά ἐστι, διηρθρωμένους δ' ἔχει καὶ χωριστοὺς ⟨τοὺς⟩[2] δακτύλους. εἰσὶ δ' ὅσοι αὐτῶν μετεωρίζονται πάντες τετραδάκτυλοι· τρεῖς μὲν γὰρ εἰς τὸ ἔμπροσθεν ἕνα δ' εἰς τὸ ὄπισθεν κείμενον ἔχουσιν οἱ πλεῖστοι ἀντὶ πτέρνης· ὀλίγοι δέ τινες δύο μὲν ἔμπροσθεν δύο δ' ὄπισθεν, οἷον ἡ καλουμένη ἴυγξ. αὕτη δ' ἐστὶ μικρῷ μὲν μείζων σπίζης, τὸ δ' εἶδος ποικίλον, ἴδια δ' ἔχει τά τε περὶ τοὺς δακτύλους καὶ τὴν γλῶτταν ὁμοίαν τοῖς ὄφεσιν· ἔχει γὰρ ἐπὶ μῆκος ἔκτασιν καὶ ἐπὶ τέτταρας δακτύλους, καὶ πάλιν συστέλλεται εἰς ἑαυτήν. ἔτι δὲ περιστρέφει τὸν τράχηλον εἰς τοὐπίσω τοῦ λοιποῦ σώματος ἠρεμοῦντος, καθάπερ οἱ ὄφεις. ὄνυχας δ'

[1] μέχρι coni. A.-W.: μεταξὺ vulg. [2] ⟨τοὺς⟩ Dt.

well. It has no spleen which is visible. It lives in holes like the lizards.[a]

XII Birds

In some of their parts birds resemble the animals we have just been discussing : they all have a head, neck, back, underside, and a counterpart of the chest. They have two legs, like man—in this respect resembling him more than any other animal does—except that birds bend their legs backwards, like quadrupeds, as we remarked earlier. Birds have no forefeet or hands, but wings—a peculiarity distinguishing them from other animals. Their haunch-bone is long, like a thigh, and attached to the body as far as the middle of the belly : the result is that when taken separately it looks as though it is a thigh, although the thigh is actually a different part, extending from it to the shin. The largest thighs and the strongest breasts are found in the crook-taloned birds. All birds have numerous claws, and all in one way or another have numerous toes : in most birds the toes are quite distinct, and the swimmers, although web-footed, have separately articulated toes. Those birds which rise well into the air all have four toes : most of them have three toes in front and one behind instead of a heel : a few have two in front and two behind, such as the bird called the wryneck. This bird is slightly larger than the chaffinch, and mottled in appearance. The arrangement of its toes is peculiar, and its tongue is like the serpent's : it can extend its tongue for a distance of four fingerbreadths and then draw it in again. Further, it can turn its neck round right back while keeping the rest of its body unmoved, like the serpent. It

[a] O. Regenbogen, " Bemerkungen zur *H.A.* des Aristoteles," in *Studi Ital. di Filos. class.*, XXVII-XXVIII, 1956, pp. 444-449, argues that ch. 11 about the chamaeleon is a later insertion. See add. note, p. 238.

504 a ἔχει μεγάλους μὲν ὁμοίως μέντοι πεφυκότας τοῖς τῶν κολιῶν[1]· τῇ δὲ φωνῇ τρίζει.

Στόμα δ' οἱ ὄρνιθες ἔχουσι μὲν ἴδιον δέ· οὔτε γὰρ χείλη οὔτ' ὀδόντας ἔχουσιν, ἀλλὰ ῥύγχος, οὔτ' ὦτα οὔτε μυκτῆρας, ἀλλὰ τοὺς πόρους τούτων τῶν αἰσθήσεων, τῶν μὲν μυκτήρων ἐν τῷ ῥύγχει, τῆς δ' ἀκοῆς ἐν τῇ κεφαλῇ. ὀφθαλμοὺς δὲ πάντες καθάπερ καὶ τἆλλα ζῷα δύο, ἄνευ βλεφαρίδων. μύουσι δ' οἱ βαρεῖς τῷ κάτω βλεφάρῳ, σκαρδαμύττουσι δ' ἐκ τοῦ κανθοῦ δέρματι ἐπιόντι πάντες, οἱ δὲ γλαυκώδεις τῶν ὀρνίθων καὶ τῷ ἄνω βλεφάρῳ. τὸ δ' αὐτὸ τοῦτο ποιοῦσι καὶ τὰ φολιδωτά, οἷον οἱ σαῦροι καὶ τἆλλα τὰ ὁμοιογενῆ τούτοις τῶν ζῴων· μύουσι γὰρ τῇ κάτω βλεφαρίδι πάντες, οὐ μέντοι σκαρδαμύττουσί γ' ὥσπερ οἱ ὄρνιθες.

Ἔτι δ' οὔτε φολίδας οὔτε τρίχας ἔχουσιν, ἀλλὰ πτερά· τὰ δὲ πτερὰ ἔχει καυλὸν ἅπαντα. καὶ οὐρὰν μὲν οὐκ ἔχουσιν, ὀρροπύγιον δέ, οἱ μὲν μακροσκελεῖς καὶ στεγανόποδες βραχύ, οἱ δ' ἐναντίοι μέγα. καὶ οὗτοι μὲν πρὸς τῇ γαστρὶ τοὺς πόδας ἔχοντες πέτονται, οἱ δὲ μικρορροπύγιοι ἐκτεταμένους. καὶ γλῶτταν ἅπαντες, ταύτην δ' ἀνομοίαν· οἱ μὲν γὰρ
504 b μακρὰν οἱ δὲ πλατεῖαν. μάλιστα δὲ τῶν ζῴων μετὰ τὸν ἄνθρωπον γράμματα φθέγγεται ἔνια τῶν ὀρνίθων γένη· τοιαῦτα δ' ἐστὶ τὰ πλατύγλωττα αὐτῶν μάλιστα. τὴν δ' ἐπιγλωττίδα ἐπὶ τῆς ἀρτηρίας οὐδὲν τῶν ᾠοτοκούντων ἔχει, ἀλλὰ συνάγει καὶ διοίγει τὸν πόρον ὥστε μηδὲν κατιέναι[2] τῶν ἐχόν-

[1] κολιῶν Rhen., Sn. : κελεῶν (quod idem valet) Dt. : κοιλιῶν A : κολοιῶν vulg. [2] AC : καθεῖναι vulg.

has large claws, though in nature they are similar to those of the green woodpecker.[a] Its note is a loud cry.

Birds have a mouth, but a peculiar one : they have neither lips nor teeth, but a beak. They have no ears or noses either, but passages serving these sensory faculties : the passages for the nostrils are in the beak, those for hearing in the head. They have, like all other animals, two eyes, but no eyelashes. The heavy birds [b] close their eyes with the lower eyelid, and all birds blink with a skin that comes up over the eye from the inner corner, whereas the owl-type of birds use also the upper eyelid. The same occurs in the animals covered with horny scales, *e.g.*, the lizards and other related animals : all of these close their eyes with the lower eyelid, but they do not blink like birds.

Furthermore, birds have neither horny scales nor hair, but feathers, and the feathers always have quills. Birds have no actual tail, but a rump [c] : the long legged and web-footed birds have a short one, the others a long one. The latter fly with their feet close up under the belly, whereas the small-rumped birds fly with their legs stretched out. All birds have a tongue, but it is not the same in all : some have a long tongue, some a broad one. More than any other animals, and second only to man, certain kinds of bird can utter articulate sounds : this faculty occurs chiefly in the broad-tongued birds. No oviparous animal has an epiglottis over the windpipe ; such creatures close and open the passage in such a way as to prevent any heavy matter passing down into the

[a] "Green woodpecker" (κολιῶν) is Schneider's restoration instead of the old reading "jackdaws" (κολοιῶν).

[b] See Table of Birds, *G.A.* (Loeb ed.), p. 368.

[c] In which the tail-feathers are set.

504 b

των βάρος ἐπὶ τὸν πνεύμονα. γένη δ' ἔνια τῶν ὀρνίθων ἔχει καὶ πλῆκτρα· γαμψώνυχον δ' ἅμα καὶ πλῆκτρον ἔχον οὐδέν. ἔστι δὲ τὰ μὲν γαμψώνυχα τῶν πτητικῶν, τὰ δὲ πληκτροφόρα τῶν βαρέων. ἔτι δ' ἔνια τῶν ὀρνέων λόφον ἔχουσι, τὰ μὲν αὐτῶν τῶν πτερῶν ἐπανεστηκότα, ὁ δ' ἀλεκτρυὼν μόνος ἴδιον· οὔτε γὰρ σάρξ ἐστιν οὔτε πόρρω σαρκὸς τὴν φύσιν.

XIII Τῶν δ' ἐνύδρων ζῴων τὸ τῶν ἰχθύων γένος ἓν ἀπὸ τῶν ἄλλων ἀφώρισται, πολλὰς περιέχον ἰδέας. Κεφαλὴν μὲν γὰρ ἔχει καὶ τὰ πρανῆ καὶ τὰ ὕπτια, ἐν ᾧ τόπῳ ἡ γαστὴρ καὶ τὰ σπλάγχνα· καὶ ὀπίσθιον οὐραῖον συνεχὲς ἔχει καὶ ἄσχιστον· τοῦτο δ' οὐ πᾶσιν ὅμοιον. αὐχένα δ' οὐδεὶς ἔχει ἰχθύς, οὐδὲ κῶλον οὐδέν, οὐδ' ὄρχεις ὅλως, οὔτ' ἐντὸς οὔτ' ἐκτός, οὐδὲ μαστούς. τοῦτο μὲν οὖν ὅλως οὐδ' ἄλλο οὐδὲν τῶν μὴ ζῳοτοκούντων, οὐδὲ τὰ ζῳοτοκοῦντα πάντα, ἀλλ' ὅσα εὐθὺς ἐν αὑτοῖς ζῳοτοκεῖ καὶ μὴ ᾠοτοκεῖ πρῶτον. καὶ γὰρ ὁ δελφὶς ζῳοτοκεῖ, διὸ ἔχει μαστοὺς δύο, οὐκ ἄνω δ' ἀλλὰ πλησίον τῶν ἄρθρων. ἔχει δ' οὐχ ὥσπερ τὰ τετράποδα ἐπιφανεῖς θηλάς, ἀλλ' οἷον ῥύακας δύο, ἑκατέρωθεν ἐκ τῶν πλαγίων ἕνα, ἐξ ὧν τὸ γάλα ῥεῖ· καὶ θηλάζεται ὑπὸ τῶν τέκνων παρακολουθούντων· καὶ τοῦτο ὦπται ἤδη ὑπό τινων φανερῶς.

Οἱ δ' ἰχθύες, ὥσπερ εἴρηται, οὔτε μαστοὺς ἔχουσιν οὔτ' αἰδοίων πόρον ἐκτὸς οὐδένα φανερόν. ἴδιον δ' ἔχουσι τό τε τῶν βραγχίων, ᾗ τὸ ὕδωρ ἀφιᾶσι δεξάμενοι κατὰ τὸ στόμα, καὶ τὰ πτερύγια, οἱ μὲν

lung. Some kinds of birds also have spurs ; but no crook-taloned bird has them. The crook-taloned birds come into the class of good fliers ; the spurred ones belong to the class of heavy birds. Further, some birds have a crest which normally is erect and consists of feathers ; the domestic cock's, however, is exceptional : the substance of it is not flesh, yet it is a close approximation to it.

XIII Fishes.

Water-animals. The tribe of fishes is a unified group, distinct from other water-animals, and includes many sorts of various appearance.

To begin with, fishes have a head, dorsal and ventral sides ; in the last-named situation are placed the belly and the viscera ; and at the rear fishes have a tail which is continuous and undivided, but not identical in all fishes. No fish has a neck, or any limb, or testicles anywhere internally or externally, and no breasts. Breasts are absent also in all the non-viviparous animals, nor are they present in all the Viviparа, but only in those which are directly internally viviparous and not previously oviparous. Thus the dolphin is viviparous, and therefore has two breasts, not in the upper part of the body but near the generative organs. It has, however, no visible teats, like quadrupeds, but has as it were two flow-holes, one on each flank, from which the milk flows, and the young follow alongside to get suckled. There are some who have actually observed this quite clearly.

Fishes, then, as I have said, have no breasts, and no externally visible generative passage. But they have two peculiarities, gills and fins : they first take in water through the mouth and then expel it through the gills [a] : most fishes have four fins, though the

[a] See note on 487 a 17, and Notes, §§ 50 f.

504 b πλεῖστοι τέτταρα, οἱ δὲ προμήκεις δύο, οἷον ἔγχελυς, ὄντα πρὸς τὰ βράγχια. ὁμοίως δὲ καὶ κεστρεῖς, οἷον ἐν Σιφαῖς οἱ ἐν τῇ λίμνῃ, δύο, καὶ ἡ καλουμένη ταινία ὡσαύτως. ἔνια δὲ τῶν προμήκων οὐδὲ πτερύγια ἔχει, οἷον σμύραινα, οὐδὲ τὰ βράγχια διηρ-
35 θρωμένα ὁμοίως τοῖς ἄλλοις ἰχθύσιν.

Αὐτῶν δὲ τῶν ἐχόντων βράγχια τὰ μὲν ἔχει ἐπι-
505 a καλύμματα τοῖς βραγχίοις, τὰ δὲ σελάχη πάντα ἀκάλυπτα. καὶ τὰ μὲν ἔχοντα καλύμματα πάντα ἐκ πλαγίου ἔχει τὰ βράγχια, τῶν δὲ σελαχῶν τὰ μὲν πλατέα κάτω ἐν τοῖς ὑπτίοις, οἷον νάρκη καὶ
5 βάτος, τὰ δὲ προμήκη ἐν τοῖς πλαγίοις, οἷον πάντα τὰ γαλεώδη. ὁ δὲ βάτραχος ἐκ πλαγίου μὲν ἔχει, καλυπτόμενα δ' οὐκ ἀκανθώδει καλύμματι ὥσπερ οἱ μὴ σελαχώδεις, ἀλλὰ δερματώδει.

Ἔτι δὲ τῶν ἐχόντων βράγχια τῶν μὲν ἁπλᾶ ἐστι τὰ βράγχια, τῶν δὲ διπλᾶ· τὸ δ' ἔσχατον πρὸς τὸ
10 σῶμα πάντων ἁπλοῦν. καὶ πάλιν τὰ μὲν ὀλίγα βράγχια ἔχει, τὰ δὲ πλῆθος βραγχίων· ἴσα δ' ἐφ' ἑκάτερα πάντες. ἔχει δ' ὁ ἐλάχιστα ἔχων ἓν ἐφ' ἑκάτερα βράγχιον, διπλοῦν δὲ τοῦτο, οἷον κάπρος· οἱ δὲ δύο ἐφ' ἑκάτερα, τὸ μὲν ἁπλοῦν τὸ δὲ διπλοῦν, οἷον γόγγρος καὶ σκάρος· οἱ δὲ τέτταρα ἐφ' ἑκάτερα
15 ἁπλᾶ, οἷον ἔλλοψ, συναγρίς, σμύραινα, ἔγχελυς· οἱ δὲ τέτταρα μὲν δίστοιχα δὲ πλὴν τοῦ ἐσχάτου, οἷον κίχλη καὶ πέρκη καὶ γλάνις καὶ κυπρῖνος. ἔχουσι

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[a] In Boeotia, near Thespis, now Tipha. Aristotle refers to this mullet (*kestreus*) again, as being found in this lake, at *P.A.* 696 a 5 and *I.A.* 708 a 5.

[b] The identification is uncertain.

elongated ones, such as the eel, have only two, and these are situated near the gills. Similarly the various species of grey mullet, *e.g.*, those in the lake at Siphae,[a] have two ; so has the so-called tape-fish.[b] Some of the elongated fishes have no fins at all, *e.g.*, the muraena, and their gills are not well articulated like those of other fishes.

Of those which have gills, some have coverings on them, though none of the Selachia has any such covering. All which have this covering have their gills placed at the side ; whereas among Selachia the broad ones have them down below on the ventral surface (examples are the torpedo-fish and the ray) ; the elongated ones have them on the sides (examples are all the dogfish). The fishing-frog has them placed at the side, and covered, not with a spiny covering as in the non-selachians, but with a covering consisting of skin.

Of fishes possessing gills, some have single ones, others double : but in all of them the last gill towards the body is single. Again, some have few gills, but others a considerable number, though all have the same number on both sides. Those which have the least have one, a double one, on each side, *e.g.*, the boar-fish ; others have two on either side, one single and one double, *e.g.*, the conger and the parrot-wrasse ; others have four single ones on either side, *e.g.*, the *ellops*, the *synagris*,[c] the muraena, and the eel ; others have four arranged in two rows (excepting the extreme one), *e.g.*, the rainbow-wrasse, the perch, the *glanis* [d] and the carp. The dogfish all have

[c] The identification of *ellops* and *synagris* is uncertain ; *ellops* is perhaps *Acipenser sturio*, a sturgeon ; *synagris* is perhaps a species of *Dentex*.

[d] See note on 568 b 13.

505 a δὲ καὶ οἱ γαλεώδεις διπλᾶ πάντες, καὶ πέντ' ἐφ' ἑκάτερα· ὁ δὲ ξιφίας ὀκτὼ διπλᾶ.

Περὶ μὲν οὖν πλήθους βραγχίων ἐν τοῖς ἰχθύσι τοῦτον ἔχει τὸν τρόπον.

Ἔτι δὲ πρὸς τἆλλα ζῷα οἱ ἰχθύες διαφέρουσι πρὸς τῇ διαφορᾷ τῇ περὶ τὰ βράγχια· οὔτε γὰρ ὥσπερ τῶν πεζῶν ὅσα ζωοτόκα ἔχει τρίχας, οὔθ' ὥσπερ ἔνια τῶν ᾠοτοκούντων τετραπόδων φολίδας, οὔθ' ὡς τὸ τῶν ὀρνέων γένος πτερωτόν, ἀλλ' οἱ μὲν πλεῖστοι αὐτῶν λεπιδωτοί εἰσιν, ὀλίγοι δέ τινες τραχεῖς, ἐλάχιστον δ' ἐστὶ πλῆθος αὐτῶν τὸ λεῖον. τῶν μὲν οὖν σελαχῶν τὰ μὲν τραχέα ἐστὶ τὰ δὲ λεῖα, γόγγροι δὲ καὶ ἐγχέλυες καὶ θύννοι τῶν λείων.

Καρχαρόδοντες δὲ πάντες οἱ ἰχθύες ἔξω τοῦ σκάρου· καὶ πάντες ἔχουσιν ὀξεῖς τοὺς ὀδόντας καὶ πολυστοίχους, καὶ ἔνιοι ἐν τῇ γλώττῃ. καὶ γλῶτταν σκληρὰν καὶ ἀκανθώδη ἔχουσι, καὶ προσπεφυκυῖαν οὕτως ὥστ' ἐνίοτε μὴ δοκεῖν ἔχειν. τὸ δὲ στόμα οἱ μὲν ἀνερρωγός, ὥσπερ ἔνια τῶν ζωοτοκούντων καὶ τετραπόδων, ⟨οἱ δὲ μύουρον⟩.[1]

Τῶν δ' αἰσθητηρίων τῶν μὲν ἄλλων οὐδὲν ἔχουσι φανερὸν οὔτ' αὐτὸ οὔτε τοὺς πόρους, οὔτ' ἀκοῆς οὔτ' ὀσφρήσεως· ὀφθαλμοὺς δὲ πάντες ἔχουσιν ἄνευ
505 b βλεφάρων, οὐ σκληρόφθαλμοι ὄντες. ἔναιμον μὲν οὖν ἐστιν ἅπαν τὸ τῶν ἰχθύων γένος, εἰσὶ δ' αὐτῶν οἱ μὲν ᾠοτόκοι οἱ δὲ ζωοτόκοι, οἱ μὲν λεπιδωτοὶ πάντες ᾠοτόκοι, τὰ δὲ σελάχη πάντα ζωοτόκα πλὴν βατράχου.

[1] coni. Dt. (cf. *P.A.* 662 a 31, 696 b 34), qui lacunam hic

double ones, five on each side ; the swordfish has eight double ones.

So much then for the number of gills as found in fishes.

Furthermore, fishes differ from other animals otherwise than in possessing gills. Unlike viviparous land-animals they have no hair, and unlike some of oviparous quadrupeds they have no horny scales, and unlike birds they have no feathers. Generally, they are covered with ordinary scales, though a few are rough-skinned, and a very small number are smooth-skinned. Some of the Selachia are rough-skinned, some smooth-skinned ; to the smooth-skinned also belong the conger, the eel, and the tunny.

All fishes are saw-toothed except the parrot-wrasse, and all have many rows of sharp teeth, some fishes having them on the tongue. Their tongue is hard and spiny, and it is so closely attached that they appear sometimes not to have one. In some the mouth is wide and gaping, as in some viviparous quadrupeds ; ⟨in others, tapering⟩.[a]

Organs of sensation. Fishes have none of these, at least none observable, except eyes—neither the organ itself nor corresponding passages either for hearing or smell. But they all have eyes, without eyelashes, though their eyes are not hard. The whole tribe of fishes is blooded. Some are oviparous, some viviparous : the scaly ones are all oviparous ; all the Selachia, except the fishing-frog, are viviparous.

[a] There is obviously a lacuna here in the Greek text, as editors point out : Dt. suggests the insertion which I have made, comparing *P.A.* 662 a 31 ; *cf.* also *P.A.* 696 b 34.

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statuit ; lacunam post *οἱ μὲν* stat. A.-W. ; nullam exhibet Σ : *οἱ μὲν ⟨σιμόν, οἱ δὲ⟩* Pi.

505 b

XIV Λοιπὸν δὲ τῶν ἐναίμων ζῴων τὸ τῶν ὄφεων γέ-
6 νος. ἔστι δὲ κοινὸν ἀμφοῖν· τὸ μὲν γὰρ πλεῖστον αὐτῶν χερσαῖόν ἐστιν, ὀλίγον δὲ τὸ τῶν ἐνύδρων ἐν τοῖς ποτίμοις ὕδασι διατελεῖ. εἰσὶ δὲ καὶ θαλάττιοι ὄφεις, παραπλήσιοι τὴν μορφὴν τοῖς χερσαίοις τἆλλα· πλὴν τὴν κεφαλὴν ἔχουσι γογγροειδεστέραν.
10 γένη δὲ πολλὰ τῶν θαλαττίων ὄφεών ἐστι, καὶ χρόαν ἔχουσι παντοδαπήν· οὐ γίγνονται δ' οὗτοι ἐν τοῖς σφόδρα βαθέσιν. ἄποδες δ' εἰσὶν οἱ ὄφεις ὥσπερ τὸ τῶν ἰχθύων γένος.

Εἰσὶ δὲ καὶ σκολόπενδραι θαλάττιαι, παραπλήσιαι τὸ εἶδος ταῖς χερσαίαις, τὸ δὲ μέγεθος μικρῷ
15 ἐλάττους· γίγνονται δὲ περὶ τοὺς πετρώδεις τόπους. τὴν δὲ χροιάν εἰσιν ἐρυθρότεραι καὶ πολύποδες μᾶλλον καὶ λεπτοσκελέστεραι τῶν χερσαίων. οὐ γίγνονται δ' οὐδ' αὗται, ὥσπερ οὐδ' οἱ ὄφεις, ἐν τοῖς βαθέσι σφόδρα.

Ἔστι δ' ἰχθύδιόν τι τῶν πετραίων, ὃ καλοῦσί τινες ἐχενηΐδα, καὶ χρῶνταί τινες αὐτῷ πρὸς δίκας
20 καὶ φίλτρα· ἔστι δὲ ἄβρωτον· τοῦτο δ' ἔνιοί φασιν

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[a] Probably a species of *Nereïs*. See also 621 a 7.

[b] Probably a blenny or goby. Pliny (*N.H.* ix. 79) also mentions the *echeneïs* as frequenting rocks, its use as a love-charm and to stop proceedings at law, and Aristotle's denial that it has feet; he confuses it, however, with the sucking-fish, also called Echeneïs; it is, he says, believed to slow down ships by sticking to their hulls (whence its name); *cf.* *N.H.* xxxii. 2, in which book he tells how Mark Antony's ship was held up by one at the battle of Actium, and Caligula's was similarly delayed on the way to Antium. It is this other echeneïs or *remora* which has become familiar in literature: see, *e.g.*, R. R. Steele, *Medieval Lore*, London, 1905, p. 134, from Bartholomaeus Anglicus (*c.* 1260) " he cleaveth to the ship, and holdeth it still stedfastly in the sea, as though the ship were on ground therein "; and references in P. Ansell

XIV Serpents, etc.

Of blooded animals there now remains the tribe of serpents. This shares the features of both classes, land- and water-animals. Most serpents are land-creatures, but a few, the aquatic ones, spend their time in fresh water. There are also sea-serpents, very similar in shape to the land-serpents in all respects, except that their heads are more like the conger's. There are many kinds of sea-serpents, and of all sorts of colours ; these do not occur in really deep water. Like the tribe of fish, serpents have no feet.

There are also sea-millipedes,[a] similar in appearance to the terrestrial ones, but slightly smaller in size. They occur in rocky places. Compared with the land-millipedes they are redder, have more feet, and more delicate legs. Like the sea-serpents, they do not occur in really deep water.

Among fish which frequent rocks, there is a very small one, which some people call the " ship-brake "[b] : some use it as a charm for law-suits and love-affairs. It is not edible. Some say it has feet ; but it has not :

Robin, *Animal Lore in English Literature*, London, 1932, p. 128, *e.g.*, Rabelais v. 30 " I saw a Remora, a little Fish call'd Echineïs by the Greeks, and near it a tall Ship, that did not get o'head an Inch, tho' she was in the Offin with Top and Top-gallants spread before the Wind. In the Days of Yore, two sorts of Fishes us'd to abound in our Courts of Judicature . . . the others [were] your beneficial Remorae's, that is, the Eternity of Law-Suits, the needless Letts that keep 'em undecided." Spenser, *Visions of the worlds vanitie*, 121 ff. "All sodainely there cloue vnto her keele | A little fish, that men call *Remora*, | Which stopt her course, and held her by the heele." Ben Jonson, *The Magnetick Lady*, II. ii. 29 f. " I say a *remora* ; | For it will stay a Ship, that's under Saile," and *id.*, *Poetaster* III. ii. 3 f. " 'Death, I am seaz'd on here | By a Land-*Remora*, I cannot stirre." See also Thompson, *G.G.F.*, *s.v.* ; and *cf.* 557 a 31.

505 b ἔχειν πόδας οὐκ ἔχον, ἀλλὰ φαίνεται διὰ τὸ τὰς πτέρυγας ὁμοίας ἔχειν ποσίν.[1]

Τὰ μὲν οὖν ἔξω μόρια, καὶ πόσα καὶ ποῖα τῶν ἐναίμων ζῴων, καὶ τίνας ἔχει πρὸς ἄλληλα διαφοράς, εἴρηται.

XV Τὰ δ' ἐντὸς πῶς ἔχει, λεκτέον ἐν τοῖς ἐναίμοις
26 ζῴοις πρῶτον· τούτῳ γὰρ διαφέρει τὰ μέγιστα γένη πρὸς τὰ λοιπὰ τῶν ἄλλων ζῴων, τῷ τὰ μὲν ἔναιμα τὰ δ' ἄναιμα εἶναι. ἔστι δὲ ταῦτα τά τε ᾠοτόκα[2] καὶ τὰ ζῳοτόκα τῶν τετραπόδων, [ἔτι δὲ καὶ τὰ ᾠοτόκα τῶν τετραπόδων][3] καὶ ὄρνις καὶ ἰχθὺς καὶ
30 κῆτος, καὶ εἴ τι ἄλλο ἀνώνυμόν ἐστι[4] διὰ τὸ μὴ εἶναι γένος ἀλλ' ἁπλοῦν τὸ εἶδος ἐπὶ τῶν καθ' ἕκαστον, οἷον ἄνθρωπος.[5]

Ὅσα μὲν οὖν ἐστι τετράποδα καὶ ζῳοτόκα, στόμαχον μὲν καὶ ἀρτηρίαν πάντ' ἔχει, καὶ κείμενα τὸν αὐτὸν τρόπον ὥσπερ ἐν τοῖς ἀνθρώποις· ὁμοίως δὲ
35 καὶ ὅσα ᾠοτοκεῖ τῶν τετραπόδων, καὶ ἐν τοῖς ὄρνι-
506 a σιν· ἀλλὰ τοῖς εἴδεσι τῶν μορίων τούτων διαφέρουσιν. ὅλως δὲ πάντα ὅσα τὸν ἀέρα δεχόμενα ἀναπνεῖ

[1] ab initio cap. hucusque secl. A.-W.
[2] τά τε ᾠοτόκα Balme : ἄνθρωπός τε vulg.
[3] om. D, Karsch, Balme.
[4] scriberes fortasse ἀνώνυμόν ἐστιν· ‹ἄλλα δ' ἀνώνυμά ἐστι› διὰ τὸ κ.τ.λ.
[5] ἄνθρωπος Balme, cf. 490 b 16 sqq. : οἷον ὄφις καὶ κροκόδειλος vulg., eiciunt Scal., Sn. : ἔχις καὶ κορδύλος coni. Dt. locus hic vexatus ; fortasse 28 ἔστι δὲ ταῦτα hucusque secludenda.

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[a] The whole of the chapter up to this point is considered an interpolation by A.-W. and Dittmeyer.

[b] There is no main group under which man falls ; hence there is no name for it. See above, note on 491 a 6.—This passage, however, even with some necessary corrections, does not square with what is stated above at 490 b 7 ff.,

though it appears to have them owing to the fact that its fins resemble feet.[a]

I have now described the external parts of blooded animals—their number, their character, and the various differences they exhibit among the various animals.

XV INSTRUMENTAL PARTS OF BLOODED ANIMALS: (b) Internal parts (resumed).

We must now go on to describe the arrangement of the internal parts, and first of all those of the blooded animals, because this is the feature in which the main groups differ from the rest of the animals : they are blooded, whereas the others are bloodless. These are the oviparous and the viviparous quadrupeds, bird, fish, cetacean, and any other there may be which is unnamed because there is no group but merely the simple type in the individual cases, for example, man.[b]

Very well then : all viviparous quadrupeds have an oesophagus and a windpipe, situated just as in human beings : and the same holds good of the oviparous quadrupeds and of birds, except that they differ in the conformation of these parts. Speaking generally, we may say that all animals which take up

b 31 ff. There, not only the 3 blooded groups (Birds, Fishes, Cetacea) appear to be reckoned as " main groups," but also the 4 bloodless groups, which are here contrasted with the " main groups." Furthermore, in the present passage the viviparous and the oviparous quadrupeds, as being blooded, are reckoned among the " main groups," whereas in the earlier passage they appear to be included among the groups which are " not *μεγάλα*," *i.e.*, groups other than the 7 *μέγιστα γένη*. The reason for these discrepancies may be that in the earlier passage Ar. is concerned to indicate the main groupings and sub-groupings of animals, and at the same time to show how impossible it is to arrive at any tidy and exhaustive classification ; whereas here he is simply giving a practical list of the blooded groups (*plus* man), which he intends to deal with first in what follows. See further, Notes, §§ 9 ff.

506 a

καὶ ἐκπνεῖ, πάντ' ἔχει πνεύμονα καὶ ἀρτηρίαν καὶ στόμαχον, καὶ τὴν θέσιν τοῦ στομάχου καὶ τῆς ἀρτηρίας ὁμοίως, ἀλλ' οὐχ ὅμοια, τὸν δὲ πνεύμονα οὔθ' ὅμοιον οὔτε τῇ θέσει ὁμοίως ἔχοντα. ἔτι δὲ καρδίαν ἅπαντ' ἔχει ὅσα αἷμα ἔχει, καὶ τὸ διάζωμα, ὃ καλοῦνται φρένες· ἀλλ' ἐν τοῖς μικροῖς διὰ λεπτότητα καὶ σμικρότητα οὐ φαίνεται ὁμοίως. (πλὴν ἐν τῇ καρδίᾳ ἴδιόν τι[1] ἐστὶν ἐπὶ τῶν βοῶν· ἔστι γάρ τι γένος βοῶν, ἀλλ' οὐ πάντες, ὃ ἔχει ἐν τῇ καρδίᾳ ὀστοῦν. ἔχει δὲ καὶ ἡ τῶν ἵππων καρδία ὀστοῦν.)[2]

Πνεύμονα δ' οὐ πάντα, οἷον ἰχθὺς οὐκ ἔχει, οὐδ' εἴ τι ἄλλο τῶν ζῴων ἔχει βράγχια. καὶ ἧπαρ ἅπαντ' ἔχει ὅσαπερ αἷμα. σπλῆνα δὲ τὰ πλεῖστα ἔχει ὅσαπερ καὶ αἷμα. τὰ δὲ πολλὰ τῶν μὴ ζῳοτόκων ἀλλ' ᾠοτόκων μικρὸν ἔχει τὸν σπλῆνα οὕτως ὥστε λανθάνειν ὀλίγου τὴν αἴσθησιν, ἔν τε τοῖς ὄρνισι τοῖς πλείστοις, οἷον ἐν περιστερᾷ καὶ ἰκτίνῳ καὶ ἱέρακι καὶ γλαυκί· ὁ δ' αἰγοκέφαλος ὅλως οὐκ ἔχει. καὶ ἐπὶ τῶν ᾠοτόκων δὲ καὶ τετραπόδων τὸν αὐτὸν τρόπον ἔχει· μικρὸν γὰρ πάμπαν ἔχουσι καὶ ταῦτα, οἷον χελώνη, ἐμύς, φρύνη, σαῦρος, κροκόδειλος, βάτραχος.

Χολὴν δὲ τῶν ζῴων τὰ μὲν ἔχει τὰ δ' οὐκ ἔχει ἐπὶ τῷ ἥπατι. τῶν μὲν ζῳοτόκων καὶ τετραπόδων ἔλαφος οὐκ ἔχει οὐδὲ πρόξ, ἔτι δ' ἵππος, ὀρεύς, ὄνος, φώκη καὶ τῶν ὑῶν ἔνιοι. τῶν δ' ἐλάφων αἱ Ἀχαΐναι καλούμεναι δοκοῦσιν ἔχειν ἐν τῇ κέρκῳ χολήν·

[1] καρδίᾳ ἴδιόν τι Sn. : ὁμοίως, πλὴν ἐν τῇ καρδίᾳ. ἴδιον δ' vulg.
[2] πλὴν . . . ὀστοῦν secl. A.-W.

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[a] The same statement is found at *P.A.* 666 b 18 (of horses and a certain kind of ox) and at *G.A.* 787 b 18 (of some bulls).
[b] Perhaps a horned owl.

air, *i.e.*, which breathe in and out, have a lung, a windpipe and an oesophagus : the position of the oesophagus and windpipe is always the same, though the organs themselves are not ; the lung may both occupy a different position and be different in character. Furthermore, all blooded animals have a heart, and a diaphragm (which is called the midriff) ; in small animals, however, owing to its slightness and smallness it is not equally obvious. (Except that a peculiarity is found in the heart in the case of oxen : there is a sort of ox which has a bone in its heart—but not all have it. There is also a bone in the horse's heart.[a])

Not all these animals have a lung : fishes have none, for example, nor has any other animal which possesses gills. All blooded animals have a liver, and most of them have a spleen, but in most of the non-viviparous, oviparous, animals it is so small that it almost escapes observation : this is so in most birds (*e.g.*, the pigeon, the kite, the hawk, the owl), and the goat-poll [b] has none at all. The situation is the same with the oviparous quadrupeds : they too have quite a small spleen, *e.g.*, the tortoise, the freshwater tortoise, the toad, the lizard, the crocodile, and the frog.

Some animals have, and some have not, a gall-bladder up against the liver. The deer is an example of a viviparous quadruped which has none : other examples are the roe, the horse, the mule, the ass, the seal, and some kinds of pig. A certain sort of deer called Achaïnae [c] appear to have gall in their tail ; (Gall-bladder.)

[c] The origin and meaning of this word are doubtful ; it occurs again at 611 b 18.

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ἔστι δ' ὃ λέγουσι τὸ μὲν χρῶμα ὅμοιον χολῇ, οὐ μέντοι ὅλον ὑγρὸν οὕτως, ἀλλ' ὅμοιον τῷ τοῦ σπληνὸς τὰ ἐντός.[1] σκώληκας μέντοι πάντες ἔχουσιν ἐν τῇ κεφαλῇ ζῶντας· ἐγγίγνονται δὲ ὑποκάτω τοῦ ὑπογλωττίου ἐν τῷ κοίλῳ καὶ περὶ τὸν σφόνδυλον, ᾗ ἡ κεφαλὴ προσπέφυκε, τὸ μέγεθος οὐκ ἐλάττους ὄντες τῶν μεγίστων εὐλῶν· ἐγγίγνονται δ' ἀθρόοι καὶ συνεχεῖς, τὸν ἀριθμὸν δ' εἰσὶ μάλιστα περὶ εἴκοσι.[2]

Χολὴν μὲν οὖν οὐκ ἔχουσιν οἱ ἔλαφοι, ὥσπερ εἴρηται· τὸ δ' ἕντερον αὐτῶν ἐστι πικρὸν οὕτως ὥστε μηδὲ τοὺς κύνας ἐθέλειν ἐσθίειν, ἂν μὴ σφόδρα
506 b πίων ᾖ ὁ ἔλαφος. ἔχει δὲ καὶ ὁ ἐλέφας τὸ ἧπαρ ἄχολον μέν, τεμνομένου μέντοι περὶ τὸν τόπον οὗ τοῖς ἔχουσιν ἐπιφύεται ἡ χολή, ῥεῖ ὑγρότης χολώδης ἢ πλείων ἢ ἐλάττων. τῶν δὲ δεχομένων τὴν θάλατταν καὶ ἐχόντων πνεύμονα δελφὶς οὐκ ἔχει χολήν. οἱ δ' ὄρνιθες καὶ οἱ ἰχθύες πάντες ἔχουσι, καὶ τὰ ᾠοτόκα καὶ τετράποδα, καὶ ὡς ἐπίπαν εἰπεῖν ἢ πλείω ἢ ἐλάττω· ἀλλ' οἱ μὲν πρὸς τῷ ἥπατι τῶν ἰχθύων, οἷον οἵ τε γαλεώδεις καὶ γλάνις καὶ ῥίνη καὶ λειόβατος καὶ νάρκη καὶ τῶν μακρῶν ἔγχελυς καὶ βελόνη καὶ ζύγαινα. ἔχει δὲ καὶ ὁ καλλιώνυμος ἐπὶ τῷ ἥπατι, ὅσπερ ἔχει μεγίστην τῶν ἰχθύων ὡς κατὰ μέγεθος. οἱ δὲ πρὸς τοῖς ἐντέροις ἔχουσιν, ἀποτεταμένην ἀπὸ τοῦ ἥπατος πόροις ἐνίοις πάνυ λεπτοῖς. ἡ μὲν οὖν ἀμία παρὰ τὸ ἕντερον παρα-

[1] ἐκτός Bekker typoth. errore.
[2] 27 σκώληκας . . . εἴκοσι secl. Saint-Hilaire, Dt.

[a] Larvae of a gadfly, *Oestrus rufibarbis*.
[b] This sentence about maggots is considered an interpolation by Dittmeyer, following Saint-Hilaire.

the substance referred to is certainly gall-like in colour, although it is not so completely fluid, and internally the part is like the inside of the spleen. All deer, however, have living maggots [a] inside their heads : they infest the hollow region under the tongue and near the vertebra to which the head is attached : these maggots are as big as the biggest grubs ; they grow in a bunch huddled up together, about twenty of them.[b]

Deer then, as I have said, have no gall-bladder : but their gut is so bitter that even dogs refuse to eat it unless the animal is exceptionally fat. In the elephant, also, the liver has no gall-bladder ; but when the animal is cut in the region where other animals' gall-bladder is situated, there comes out a gall-like fluid in greater or less quantity. An example of an animal which takes in sea-water and has a lung, but lacks a gall-bladder, is the dolphin. Birds and fishes all have one, so have the oviparous quadrupeds, generally speaking, larger or smaller in size. Some fishes, however, have it close to the liver, *e.g.*, the dogfishes, the *glanis*, the angel-fish, the skate, the torpedo-fish, and (these are elongated fishes) the eel, the pipefish, and the hammer-headed shark. The *kallionymos*,[c] too, has it close to the liver, and this fish has a larger one for its size than any other fish. Others have it by the gut, attached to the liver by very narrow passages. The bonito [d] has its gall-bladder extending alongside the gut and equal to it

[c] The identification is uncertain ; perhaps *Uranoscopus scaber*.

[d] *Sarda* [formerly *Pelamys*] *sarda*, a small tunny, the mainstay of the Black Sea fishery, whereas the true tunny is commoner in the Mediterranean (D'Arcy Thompson). See also 488 a 6.

506 b

τεταμένην ἰσομήκη ἔχει, πολλάκις δὲ καὶ ἐπανα-
15 δίπλωμα· οἱ δ' ἄλλοι πρὸς τοῖς ἐντέροις οἱ μὲν πορρώτερον οἱ δ' ἐγγύτερον, οἷον βάτραχος, ἔλλοψ, συναγρίς, σμύραινα, ξιφίας. πολλάκις δὲ καὶ τὸ αὐτὸ γένος ἐπ' ἀμφότερα φαίνεται ἔχον, οἷον γόγγροι οἱ μὲν πρὸς τῷ ἤπατι, οἱ δὲ κάτω ἀπηρτημένην. ὁμοίως δ' ἔχει τοῦτο καὶ ἐπὶ τῶν ὀρνίθων· ἔνιοι γὰρ
20 πρὸς τῇ κοιλίᾳ ἔχουσιν, οἱ δὲ πρὸς τοῖς ἐντέροις τὴν χολήν, οἷον περιστερά, κόραξ, ὄρτυξ, χελιδών, στρουθός. ἔνιοι δ' ἅμα πρὸς τῷ ἤπατι ἔχουσι καὶ πρὸς τῇ κοιλίᾳ, οἷον αἰγοκέφαλος, οἱ δ' ἅμα πρὸς τῷ ἤπατι καὶ τοῖς ἐντέροις, οἷον ἱέραξ καὶ ἰκτῖνος.

XVI Νεφροὺς δὲ καὶ κύστιν τὰ μὲν ζωοτόκα τῶν τε-
26 τραπόδων πάντ' ἔχει· ὅσα δ' ᾠοτοκεῖ, τῶν μὲν ἄλλων οὐδὲν ἔχει, οἷον οὔτ' ὄρνις οὔτ' ἰχθύς, τῶν δὲ τετραπόδων μόνη χελώνη ἡ θαλαττία μέγεθος κατὰ λόγον τῶν ἄλλων μορίων. ὁμοίους δ' ἔχει τοὺς νεφροὺς ἡ θαλαττία χελώνη τοῖς βοείοις· ἔστι δ' ὁ
30 τοῦ βοὸς οἷον ἐκ πολλῶν μικρῶν εἰς συγκείμενος. (ἔχει δὲ καὶ ὁ βόνασος τὰ ἐντὸς ἅπαντα ὅμοια βοΐ.)[1]

Τῇ δὲ θέσει, ὅσα ἔχει ταῦτα τὰ μόρια, ὁμοίως
XVII κείμενα ἔχει, τήν τε καρδίαν περὶ τὸ μέσον, πλὴν
507 a ἐν ἀνθρώπῳ· οὗτος δ' ἐν τῷ ἀριστερῷ μᾶλλον μέρει, καθάπερ ἐλέχθη πρότερον. ἔχει δὲ καὶ τὸ ὀξὺ ἡ καρδία πάντων εἰς τὸ πρόσθεν· πλὴν ἐπὶ τῶν ἰχθύων οὐκ ἂν δόξειεν· οὐ γὰρ πρὸς τὸ στῆθος ἔχει τὸ ὀξύ,
5 ἀλλὰ πρὸς τὴν κεφαλὴν καὶ τὸ στόμα. ἀνήρτηται δ' αὐλῷ[2] τὸ ἄκρον ᾗ συνάπτει τὰ βράγχια ἀλλήλοις

[1] ἔχει . . . βοΐ secl. A.-W.
[2] αὐλῷ A.-W. : αὐτῷ PD : αὐτῶν vulg.

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[a] See note on 505 a 15.

in length, and often there is a double fold to it. Others have the gall-bladder near the gut, some further off, some closer to it ; examples are the fishing-frog, the *ellops*, the *synagris*,[a] the muraena, the sword-fish. Often we find two different positions in the same group of animals : *e.g.*, some congers have it near the liver, others have it below and detached from the liver. The same is found in birds : some have the gall-bladder near the stomach, others near the gut, *e.g.*, the pigeon, the raven, the quail, the swallow, and the sparrow ; some have it at one and the same time close to the liver and close to the stomach, *e.g.*, the goat-poll ; some have it at one and the same time close to the liver and close to the gut, *e.g.*, the hawk and the kite.

Kidneys and Bladder. All viviparous quadrupeds XVI have these parts. None of the non-quadrupedal Ovipara, whether birds or fishes, has them ; and of the quadrupedal Ovipara the turtle is the only one which has kidneys and bladder proportionate in size to its other parts. The kidneys of the turtle are similar to those of the ox ; the ox's kidney is as it were one organ consisting of many small ones. (All the internal organs of the bison, too, are similar to those of the ox.)

With regard to situation, these parts, in the animals that have them, are similarly placed, and the heart is XVII situated about the middle, except in man : in man it is somewhat over towards the left, as we have said before. In all animals the pointed end of the heart lies forward, though in fishes it might appear not to do so : the reason is that the pointed end is not towards the breast but towards the head and the mouth ; and the apex is attached to a tube where the right and

507 a

τὰ δεξιὰ καὶ τὰ ἀριστερά. εἰσὶ δὲ καὶ ἄλλοι πόροι τεταμένοι ἐξ αὐτῆς εἰς ἕκαστον τῶν βραγχίων, μείζους μὲν τοῖς μείζοσιν, ἐλάττους δὲ τοῖς ἐλάττοσιν· ὁ δ' ἐπ' ἄκρας τῆς καρδίας τοῖς μεγάλοις αὐτῶν σφόδρα παχὺς αὐλός ἐστι καὶ λευκός.

Στόμαχον δ' ὀλίγοι ἔχουσι τῶν ἰχθύων, οἷον γόγγρος καὶ ἔγχελυς, καὶ οὗτοι μικρόν.

Καὶ τὸ ἦπαρ τοῖς ἔχουσι τοῖς μὲν ἀσχιδὲς ἔχουσίν ἐστιν[1] ἐν τοῖς δεξιοῖς ὅλον, τοῖς δ' ἐσχισμένον ἀπ' ἀρχῆς τὸ μεῖζον ἐν τοῖς δεξιοῖς. ἐνίοις γὰρ ἑκάτερον τὸ μόριον ἀπήρτηται καὶ οὐ συμπέφυκεν ἡ ἀρχή, οἷον τῶν τ' ἰχθύων τοῖς γαλεώδεσι, καὶ δασυπόδων τι γένος ἐστὶ καὶ ἄλλοθι καὶ περὶ τὴν λίμνην τὴν Βόλβην ἐν τῇ καλουμένῃ Συκίνῃ, οὓς ἄν τις δόξειε δύο ἥπατα ἔχειν διὰ τὸ πόρρω τοὺς πόρους[2] συνάπτειν, ὥσπερ καὶ ἐπὶ τοῦ τῶν ὀρνίθων πνεύμονος.

Καὶ ὁ σπλὴν δ' ἐστὶ πᾶσιν ἐν τοῖς ἀριστεροῖς κατὰ φύσιν. καὶ οἱ νεφροὶ τοῖς ἔχουσι κείμενοι τὸν αὐτὸν τρόπον. ἤδη δὲ διανοιχθέν τι τῶν τετραπόδων ὤφθη ἔχον τὸν σπλῆνα μὲν ἐν τοῖς δεξιοῖς, τὸ δ' ἦπαρ ἐν τοῖς ἀριστεροῖς· ἀλλὰ τὰ τοιαῦτα ὡς τέρατα κρίνεται.

Τείνει δ' ἡ μὲν ἀρτηρία πᾶσιν εἰς τὸν πνεύμονα (ὃν δὲ τρόπον, ὕστερον ἐροῦμεν), ὁ δὲ στόμαχος εἰς τὴν κοιλίαν διὰ τοῦ διαζώματος ὅσα ἔχει στόμαχον· οἱ γὰρ ἰχθύες, ὥσπερ εἴρηται πρότερον, οἱ πλεῖστοι οὐκ ἔχουσιν, ἀλλ' εὐθὺς πρὸς τὸ στόμα συνάπτει ἡ

[1] ἐστιν hic AC, ante ὅλον PD, vulg.
[2] λοβοὺς Sn. : μόρια Scal. : *partes* Σ.

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[a] In Macedonia, to the north of Chalcidicê, not far from Stagirus. Mentioned by Thucydides i. 58.

[b] This phenomenon is mentioned again at *P.A.* 669 b 35,

left gills meet. There are other passages as well extending from the heart to each of the gills, larger in the larger fishes, smaller in the smaller ones ; but in the large ones the passage at the apex of the heart is a very stout tube, and white in colour.

A few fishes have an oesophagus, *e.g.*, the conger and the eel ; but even they have only a small one.

The liver, in those that have an undivided one, is entirely on the right side ; in those which have one which is divided from the start, the larger portion is on the right side ; for of course there are some fishes in which the two parts are completely detached and are not joined at the start, *e.g.*, the dogfishes, and there is also a kind of hare in what is known as the Fig country near Lake Bolbê,[a] as well as in other places, which one might well think had two livers [b] owing to the length of the connecting passages, similar to the arrangement with the lungs of birds.

The normal and natural place for the spleen in all animals is on the left side. And the kidneys, in those that have them, are situated identically.[c] Cases have been observed in dissected quadrupeds of the spleen situated on the right side and the liver on the left ; but these are reckoned as monstrosities.

In all animals the windpipe extends to the lung (we shall explain the manner of this later), and the oesophagus (if present) extends to the stomach through the midriff. If present—for, as has been said earlier, most fishes have none, and the stomach connects immediately with the mouth, so that often, when

though the location is more vaguely stated : " in some districts."

[c] *i.e.*, in the same position in all animals that have them.

507 a κοιλία, διὸ πολλάκις ἐνίοις τῶν μεγάλων διώκουσι τοὺς ἐλάττους προπίπτει ἡ κοιλία εἰς τὸ στόμα.
30 Ἔχει δὲ κοιλίαν πάντα μὲν τὰ εἰρημένα, καὶ κειμένην ὁμοίως (κεῖται γὰρ ὑπὸ τὸ διάζωμα εὐθύς), καὶ τὸ ἕντερον ἐχόμενον καὶ τελευτῶν πρὸς τὴν ἔξοδον τῆς τροφῆς καὶ τὸν καλούμενον ἀρχόν. ἀνομοίας δ' ἔχουσι τὰς κοιλίας. πρῶτον μὲν γὰρ τῶν τετραπόδων καὶ ζωοτόκων ὅσα μή ἐστιν ἀμφώδοντα
35 τῶν κερατοφόρων, τέτταρας ἔχει τοὺς τοιούτους τόπους[1]· ἃ δὴ καὶ λέγεται μηρυκάζειν. διήκει γὰρ ὁ μὲν στόμαχος ἀπὸ τοῦ στόματος ἀρξάμενος ἐπὶ τὰ
507 b κάτω παρὰ τὸν πνεύμονα, ἀπὸ τοῦ διαζώματος ἐπὶ τὴν κοιλίαν τὴν μεγάλην· αὕτη δ' ἐστὶ τὰ ἔσω τραχεῖα καὶ διειλημμένη· συνήρτηται δ' αὐτῇ πλησίον τῆς τοῦ στομάχου προσβολῆς ὁ καλούμενος κεκρύφαλος ἀπὸ τῆς ὄψεως· ἔστι γὰρ τὰ μὲν ἔξωθεν
5 ὅμοιος τῇ κοιλίᾳ, τὰ δ' ἐντὸς ὅμοιος τοῖς πλεκτοῖς κεκρυφάλοις· μεγέθει δὲ πολὺ ἐλάττων ἐστὶν ὁ κεκρύφαλος τῆς κοιλίας. τούτου δ' ἔχεται ὁ ἐχῖνος, τὰ ἐντὸς ὢν τραχὺς καὶ πλακώδης, τὸ δὲ μέγεθος παραπλήσιος τῷ κεκρυφάλῳ. μετὰ δὲ τοῦτον τὸ καλούμενον ἤνυστρόν ἐστι, τῷ μὲν μεγέθει τοῦ
10 ἐχίνου μεῖζον, τὸ δὲ σχῆμα προμηκέστερον· ἔχει δ' ἐντὸς πλάκας πολλὰς καὶ μεγάλας καὶ λείας. ἀπὸ δὲ τούτου τὸ ἔντερον ἤδη.

Τὰ μὲν οὖν κερατοφόρα καὶ μὴ ἀμφώδοντα τοιαύτην ἔχει τὴν κοιλίαν, διαφέρει δὲ πρὸς ἄλληλα τοῖς σχήμασι καὶ τοῖς μεγέθεσι τούτων τε καὶ τῷ

[1] τόπους Sn. : *ventres* Σ : πόρους vulg.

some of the large fishes are chasing smaller ones, their stomach [a] falls forward into the mouth.

All the animals we have mentioned have a stomach, and it is similarly situated (*i.e.*, it is situated immediately under the midriff), and they have a gut connected to it and terminating at the outlet for the nourishment—what is called the rectum. But there are dissimilarities about the stomach. To begin with, those viviparous quadrupeds which are horned and do not have teeth in both jaws, have four chambers of this kind : these of course are the animals which are said to " chew the cud." In these animals, the oesophagus begins from the mouth and passes downwards beside the lung, from the midriff as far as the great stomach ; internally this stomach is rough and partitioned ; and connected to it near the entrance of the oesophagus is the " hair-net " [b] as it is called owing to its appearance : outside it is like the stomach, but inside it resembles a plaited hair-net ; it is much smaller in size than the stomach. Connected to it is the *echinus*,[c] which is rough internally and laminated, comparable in size to the " hair-net." After that is the *enystron*, as it is called,[d] larger than the *echinus*, and more elongated in shape : internally it has many large, smooth folds. Immediately after this is the gut.

Such is the formation of the stomach in the horned animals which have not teeth in both jaws, though they differ from one another in respect of the shape and size of these parts, and also because in some the

[a] Actually the air-bladder (Th.) ; *cf.* 591 b 6.

[b] The *reticulum*, or honeycomb(-bag).

[c] The many-plies. *Echinus* is a word applied to several other objects, including the hedgehog, the sea-urchin, a large wide-mouthed jar, the hard core of beechnuts, chestnuts, etc.

[d] The *abomasum*.

507 b

τὸν στόμαχον εἰς μέσην ἢ πλαγίαν τείνειν τὴν κοιλίαν.

Τὰ δ' ἀμφώδοντα μίαν ἔχει κοιλίαν, οἷον ἄνθρωπος, ὗς, κύων, ἄρκτος, λέων, λύκος. ἔχει δὲ καὶ ὁ θὼς πάντα τὰ ἐντὸς ὅμοια λύκῳ. πάντα μὲν οὖν ἔχει μίαν κοιλίαν, καὶ μετὰ ταῦτα τὸ ἔντερον· ἀλλὰ τὰ μὲν ἔχει μείζω τὴν κοιλίαν, ὥσπερ ὗς καὶ ἄρκτος (καὶ ἥ γε τῆς ὑὸς ὀλίγας ἔχει λείας πλάκας), τὰ δὲ πολὺ ἐλάττω καὶ οὐ πολλῷ μείζω τοῦ ἐντέρου, καθάπερ κύων καὶ λέων καὶ ἄνθρωπος. καὶ τῶν ἄλλων δὲ τὰ εἴδη διέστηκε πρὸς τὰς τούτων κοιλίας· τὰ μὲν γὰρ ὑΐ ὁμοίαν ἔχει τὰ δὲ κυνί, καὶ τὰ μείζω καὶ τὰ ἐλάττω τῶν ζῴων ὡσαύτως. διαφορὰ δὲ καὶ ἐν τούτοις κατὰ τὰ μεγέθη καὶ τὰ σχήματα καὶ πάχη καὶ λεπτότητας ὑπάρχει τὰς τῆς κοιλίας, καὶ κατὰ τοῦ στομάχου τὴν θέσιν καὶ σύντρησιν.[1]

Διαφέρει δὲ καὶ ἡ τῶν ἐντέρων φύσις ἑκατέροις τῶν εἰρημένων ζῴων, τοῖς τε μὴ ἀμφώδουσι καὶ τοῖς ἀμφώδουσι, τῷ μεγέθει καὶ πάχει καὶ ταῖς ἐπαναδιπλώσεσιν.

Πάντα δὲ μείζω τὰ τῶν μὴ ἀμφωδόντων ἐστίν· καὶ γὰρ αὐτὰ πάντα μείζω· μικρὰ μὲν γὰρ ὀλίγα, πάμπαν δὲ μικρὸν οὐδέν ἐστι κερατοφόρον. ἔχουσι δ' ἔνια καὶ ἀποφυάδας τῶν ἐντέρων, εὐθυέντερον δ' οὐδέν ἐστι μὴ ἀμφώδουν.

'Ο δ' ἐλέφας ἔντερον ἔχει συμφύσεις ἔχον, ὥστε φαίνεσθαι τέτταρας κοιλίας ἔχειν. ἐν τούτῳ καὶ ἡ τροφὴ ἐγγίγνεται, χωρὶς δ' οὐκ ἔχει ἀγγεῖον. καὶ
508 a τὰ σπλάγχνα ἔχει παραπλήσια τοῖς ὑείοις, πλὴν τὸ

[1] sic A.-W. : κατὰ τοῦ στομάχου τῇ θέσει τὴν σύντρησιν vulg.

[a] *Mustela erminea.* See Ingo Krumbiegel, " Die Thos-

oesophagus joins up to the stomach centrally, and in others sideways.

Animals with teeth in both jaws have one stomach only, *e.g.*, man, the pig, the dog, the bear, the lion, and the wolf. The stoat,[a] too, has all its internal parts similar to the wolf. All these, then, have one stomach, and following after that the gut. But there are differences. Some have a comparatively large stomach (*e.g.*, the pig and the bear ; the pig's stomach has a few smooth folds in it) ; some have a much smaller one, not much larger than the gut, e.g., the dog, the lion, and man. As for the others, the shape of their stomach tends towards one or other of those just mentioned : in some it resembles the pig's, in others the dog's, both in larger and smaller animals. In these animals also differences occur with regard to the size, shape, and thickness or thinness of the stomach, and also to the position where the orifice of the oesophagus comes into it.

The structure of the gut also differs in each of the two groups of animals mentioned, *viz.*, those with and without front teeth in the upper jaw, in size, in thickness, and in the character of its folds.

In the non-ambidentate animals, the intestines are all larger ; indeed, all the animals themselves are larger : few of them are small, and no horned animal is minute. Some animals have appendages to the gut ; but no non-ambidentate animal has a straight gut.

The elephant's gut has constrictions, which make it appear to have four stomachs. This gut is where the food has its place : the elephant has no separate receptacle. Its viscera resemble the pig's, except

Tiere des Aristoteles," *Archeion*, XVI (1934), pp. 24-37. Others identify with the jackal or civet.

508 a

μὲν ἧπαρ τετραπλάσιον τοῦ βοείου καὶ τἆλλα, τὸν δὲ σπλῆνα ἐλάττω ἢ κατὰ λόγον.

Τὸν αὐτὸν δὲ τρόπον ἔχει τὰ περὶ τὴν κοιλίαν καὶ τὴν τῶν ἐντέρων φύσιν καὶ τοῖς τετράποσι μὲν τῶν ζῴων ᾠοτόκοις δέ, οἷον χελώνῃ χερσαίᾳ καὶ χελώνῃ θαλαττίᾳ καὶ σαύρᾳ καὶ τοῖς κροκοδείλοις ἀμφοῖν καὶ πᾶσιν ὅλως[1] τοῖς τοιούτοις· ἁπλῆν τε γὰρ ἔχουσι καὶ μίαν τὴν κοιλίαν, καὶ τὰ μὲν ὁμοίαν τῇ ὑείᾳ, τὰ δὲ τῇ τοῦ κυνός.

Τὸ δὲ τῶν ὄφεων γένος ὅμοιόν ἐστι καὶ ἔχει παραπλήσια σχεδὸν πάντα τῶν πεζῶν καὶ ᾠοτόκων τοῖς σαύροις, εἴ τις μῆκος αὐτοῖς ἀποδοὺς ἀφέλοι τοὺς πόδας. φολιδωτόν τε γάρ ἐστι, καὶ τὰ πρανῆ καὶ τὰ ὕπτια παραπλήσια τούτοις ἔχει· πλὴν ὄρχεις οὐκ ἔχει, ἀλλ' ὥσπερ ἰχθὺς δύο πόρους εἰς ἓν συνάπτοντας καὶ τὴν ὑστέραν μακρὰν καὶ δικρόαν. τὰ δ' ἄλλα τὰ ἐντὸς τὰ αὐτὰ τοῖς σαύροις, πλὴν ἅπαντα διὰ τὴν στενότητα καὶ τὸ μῆκος στενὰ καὶ μακρὰ τὰ σπλάγχνα, ὥστε καὶ λανθάνειν διὰ τὴν ὁμοιότητα τῶν σχημάτων· τήν τε γὰρ ἀρτηρίαν ἔχει σφόδρα μακράν, ἔτι δὲ μακρότερον τὸν στόμαχον. ἀρχὴ δὲ τῆς ἀρτηρίας πρὸς αὐτῷ ἐστι τῷ στόματι, ὥστε δοκεῖν ὑπὸ ταύτην εἶναι τὴν γλῶτταν. προέχειν δὲ δοκεῖ τῆς γλώττης ἡ ἀρτηρία διὰ τὸ συσπᾶσθαι τὴν γλῶτταν καὶ μὴ μένειν ὥσπερ τοῖς ἄλλοις. ἔστι δ' ἡ γλῶττα λεπτὴ καὶ μακρὰ καὶ μέλαινα, καὶ ἐξέρχεται μέχρι πόρρω· ἴδιον δὲ παρὰ τὰς τῶν ἄλλων γλώττας ἔχουσι καὶ οἱ ὄφεις καὶ οἱ σαῦροι τὸ δικρόαν αὐτῶν εἶναι τὴν γλῶτταν

[1] ὅλως AC : ὁμοίως PD, vulg.

that its liver is four times as large as the ox's, as are its other internal parts, though its spleen is disproportionately small.

The arrangements with regard to the stomach and the gut are the same in the oviparous quadrupeds as well, *e.g.*, the land-tortoise, the turtle, the lizard, both types of crocodile, and generally all animals of this sort : they have a single stomach, simple in formation, resembling in some cases the pig's, in others the dog's.

Serpents as a class are similar and their parts are practically all comparable with a class which is included among the oviparous land-animals, *viz.*, the lizards—if one were to increase their length and take away their feet. In other words, the serpent has horny scales, and its dorsal and ventral parts resemble those of the lizard; it has, however, no testicles, but, like fishes, two passages which converge into one, and a long bifurcated ovary. The rest of the internal organs are identical with the lizard's, except that owing to its length and narrowness its viscera are long and narrow, so that it is difficult to recognize them on account of the similarity of their shapes. Thus, for instance, its windpipe is very long, and its oesophagus even longer. The beginning of the windpipe is right up against the mouth, so that the tongue appears to be underneath the windpipe ; and the windpipe seems to stick out in front of the tongue because the tongue gets drawn back and does not stay where it normally does in other animals. Furthermore, the tongue is thin and long, and black, and will come out a long way. Compared with the tongues of other animals, those of serpents and lizards have the peculiarity of being forked at the tip ; and this fea- (Serpents.)

508 a ἄκραν, πολὺ δὲ μάλιστα οἱ ὄφεις· τὰ γὰρ ἄκρα αὐτῶν ἐστι λεπτὰ ὥσπερ τρίχες. ἔχει δὲ καὶ ἡ φώκη ἐσχισμένην τὴν γλῶτταν.

Τὴν δὲ κοιλίαν ὁ ὄφις ἔχει οἷον ἔντερον εὐρυχωρέστερον, ὁμοίαν τῇ τοῦ κυνός· εἶτα τὸ ἔντερον μακρὸν καὶ λεπτὸν καὶ μέχρι τοῦ τέλους ἕν. ἐπὶ δὲ τοῦ φάρυγγος ἡ καρδία μικρὰ[1] καὶ νεφροειδής· διὸ δόξειεν ἂν ἐνίοτε οὐ πρὸς τὸ στῆθος ἔχειν τὸ ὀξύ. εἶθ' ὁ πνεύμων ἁπλοῦς, ἰνώδει πόρῳ διηρθρωμένος καὶ μακρὸς σφόδρα καὶ πολὺ ἀπηρτημένος τῆς καρδίας. καὶ τὸ ἧπαρ μακρὸν καὶ ἁπλοῦν, σπλῆνα δὲ μικρὸν καὶ στρογγύλον, ὥσπερ καὶ οἱ σαῦροι. χολὴν
508 b δ' ἔχει ὁμοίως τοῖς ἰχθύσιν· οἱ μὲν γὰρ ὕδροι πρὸς[2] τῷ ἥπατι ἔχουσιν, οἱ δ' ἄλλοι πρὸς τοῖς ἐντέροις ὡς ἐπὶ τὸ πολύ. καρχαρόδοντες δὲ πάντες εἰσίν. πλευρὰς δ' ἔχουσιν ἴσας ταῖς ἐν τῷ μηνὶ ἡμέραις· τριάκοντα γὰρ ἔχουσιν.

Λέγουσι δέ τινες συμβαίνειν περὶ τοὺς ὄφεις τὸ αὐτὸ ὅπερ καὶ περὶ τοὺς νεοττοὺς τοὺς τῶν χελιδόνων· ἐὰν γάρ τις ἐκκεντήσῃ τὰ ὄμματα τῶν ὄφεων, φασὶ φύεσθαι πάλιν. καὶ αἱ κέρκοι δ' ἀποτεμνόμεναι τῶν τε σαύρων καὶ τῶν ὄφεων φύονται.[3]

Ὡσαύτως δὲ καὶ τοῖς ἰχθύσιν ἔχει τὰ περὶ τὰ ἔντερα καὶ τὴν κοιλίαν. μίαν γὰρ καὶ ἁπλῆν ἔχουσι, διαφέρουσαν τοῖς σχήμασιν. ἔνιοι γὰρ πάμ-

[1] καρδία, μικρὰ δὲ vulg.: κ. μικρὰ καὶ μακρὰ (omisso δὲ) AC: κ. μικρὰ μακρὰ PD.
[2] πρὸς AC: ἐπὶ PD, vulg.
[3] λέγουσι hucusque secl. A.-W.

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[a] *Cf. G.A.* 774 b 31, where Aristotle again mentions this phenomenon: the eyes of young swallows, if pricked out, will recover: the birds are born blind, hence the injury occurs

ture is specially marked in the serpents, the tips of whose tongues are as fine as hairs. The seal, too, has a divided tongue.

The serpent's stomach is rather like a more capacious gut, resembling the dog's ; beyond it is the gut itself, which is long and narrow and single right to its end. The heart is near the pharynx : it is small and long and looks like a kidney ; hence it may sometimes appear as though its pointed end were not facing towards the chest. Next is the lung, simple, and articulated with a fibrous passage ; it is very long and well separated from the heart. The liver is long and simple ; the spleen short and round, as in lizards. Its gall-bladder resembles that of fishes : in the water-snakes it is close to the liver, in others generally near the gut. All serpents are saw-toothed. The number of their ribs is the same as the days in the month—thirty.

Some say that serpents have the same faculty as swallow-chicks : that if anyone pricks their eyes out they grow again. The tails, too, of lizards and serpents grow again if they are cut off.[a]

A similar arrangement of the gut and stomach occurs also in fishes. They have one simple stomach, though its shape varies in different fishes. Some of

during the process of formation, not after its completion. Aristotle thus recognizes the connexion between regeneration and embryonic growth. A similar phenomenon is the well-known " Wolffian regeneration " in amphibia, where after removal of the lens of the eye a new lens regenerates from the margin of the iris, *i.e.*, from a place other than that of its normal origin, *viz.*, the embryonic skin ; in newts and salamanders this may be repeated as often as twenty times. These animals retain the faculty of regeneration throughout adult life. See J. Needham, *Biochemistry and Morphogenesis*, 1942, pp. 295 ff. *Cf.* 563 a 14 ff.

508 b

παν ἐντεροειδῆ[1] ἔχουσιν, οἷον ὃν καλοῦσι σκάρον, ὃς δὴ καὶ δοκεῖ μόνος ἰχθὺς μηρυκάζειν. καὶ τὸ τοῦ ἐντέρου δὲ μέγεθος ἁπλοῦν, κἂν ἀναδίπλωσιν ἔχῃ,[2] ἀναλύεται εἰς ἕν.

Ἴδιον δὲ τῶν ἰχθύων ἐστὶ καὶ τῶν ὀρνίθων τῶν πλείστων τὸ ἔχειν ἀποφυάδας· ἀλλ' οἱ μὲν ὄρνιθες κάτωθεν καὶ ὀλίγας, οἱ δ' ἰχθύες ἄνωθεν περὶ τὴν κοιλίαν, καὶ ἔνιοι πολλάς, οἷον κωβιός, γαλῇ,[3] πέρκη, σκορπίος, κίθαρος, τρίγλη, σπάρος· ὁ δὲ κεστρεὺς ἐπὶ μὲν θάτερα τῆς κοιλίας πολλάς, ἐπὶ δὲ θάτερα μίαν. ἔνιοι δ' ἔχουσι μὲν ὀλίγας δέ, οἷον ἥπατος, γλαῦκος· ἔχει δὲ καὶ ὁ χρύσοφρυς ὀλίγας. διαφέρουσι δὲ καὶ αὐτοὶ αὑτῶν, οἷον χρύσοφρυς ὁ μὲν πλείους ἔχει ὁ δ' ἐλάττους. εἰσὶ δὲ καὶ οἳ ὅλως οὐκ ἔχουσιν, οἷον οἱ πλεῖστοι τῶν σελαχωδῶν· τῶν δ' ἄλλων οἱ μὲν ὀλίγας, οἱ δὲ καὶ πάνυ πολλάς. πάντες δὲ παρ' αὐτὴν ἔχουσι τὴν κοιλίαν τὰς ἀποφυάδας οἱ ἰχθύες.

Οἱ δ' ὄρνιθες ἔχουσι καὶ πρὸς ἀλλήλους καὶ πρὸς τἆλλα ζῷα περὶ τὰ ἐντὸς μέρη διαφοράν. οἱ μὲν γὰρ ἔχουσι πρὸ τῆς κοιλίας πρόλοβον, οἷον ἀλεκτρυών, φάττα, περιστερά, πέρδιξ· ἔστι δ' ὁ πρόλοβος δέρμα κοῖλον καὶ μέγα, ἐν ᾧ ἡ τροφὴ πρώτη εἰσιοῦσα ἄπεπτός ἐστιν. ἔστι δ' αὐτόθεν[4] μὲν ἀπὸ τοῦ

[1] sic PΣ, vulg. : ἑτεροειδῆ ACD.
[2] correxit Pi. : καὶ ἀναδ. ἔχει ὃ vulg., codd. varia.
[3] γαλῇ Sn. : γαλεός vulg.
[4] Sn. ex Rhen., m, Ambros. : αὐτόθι codd., vulg.

[a] The pyloric caeca.
[b] The MSS. read γαλεός, the dogfish, but like all Selachia

them have a completely gut-like stomach, *e.g.*, the fish known as the parrot-wrasse, which, we may note, appears to be the only fish that chews the cud. Further, the whole length of the gut is simple, and if it should have a convolution in it, it straightens out into a single passage.

The possession of appendages [a] to the gut is a peculiarity of fishes and of most birds. In birds they are low down and few in number ; in fishes high up near the stomach, and sometimes they are quite numerous, as, *e.g.*, in the goby, the burbot,[b] the perch, the *skorpios*,[c] the *kitharos*,[d] the red mullet, and the sea-bream ; the grey mullet has a number of them on one side of the stomach, and one on the other side. Some have them, but have only a few, *e.g.*, the *hepatos* [d] and the *glaukos*.[d] Another which has a few only is the gilthead. These fishes also differ from one another : thus one gilthead will have more, another fewer. There are some fishes which have none at all, *e.g.*, the majority of the Selachia. Of the remainder, some have few, some very many. Always, in fishes, these appendages are found near the stomach.

Birds. Birds differ both from each other and from the other animals in respect of their internal parts. Some for instance have a crop in front of the stomach, as the domestic fowl, the ringdove, the pigeon, and the partridge. This crop is a large hollow skin, into which the food comes at its first stage and is still unconcocted.[e] The crop from this point, where it leaves the oeso-

this has no caeca. Schneider suggests γαλῆ, the burbot, a member of the cod family.

[c] *Skorpios*, a species of *Scorpaena* (bullhead or sculpin).

[d] *Kitharos*, *hepatos*, *glaukos*, unidentified fishes. Kitharos may be the lantern-flounder.

[e] See Notes, §§ 19 ff.

508 b στομάχου στενότερος, ἔπειτα εὐρύτερος, ᾗ δὲ καθήκει πάλιν πρὸς τὴν κοιλίαν, λεπτότερος. τὴν δὲ κοιλίαν σαρκώδη καὶ στιφρὰν οἱ πλεῖστοι ἔχουσι, καὶ ἔσωθεν δέρμα ἰσχυρὸν καὶ[1] ἀφαιρούμενον ἀπὸ τοῦ σαρκώδους. οἱ δὲ πρόλοβον μὲν οὐκ ἔχουσιν, ἀλλ' ἀντὶ τούτου τὸν στόμαχον εὐρὺν καὶ πλατύν, ἢ δι' ὅλου ἢ τὸ πρὸς τὴν κοιλίαν τεῖνον, οἷον κολοιὸς
509 a καὶ κόραξ καὶ κορώνη. ἔχει δὲ καὶ ὁ ὄρτυξ τοῦ στομάχου τὸ πλατὺ κάτω, καὶ ὁ αἰγοκέφαλος μικρὸν εὐρύτερον τὸ κάτω καὶ ἡ γλαύξ. νῆττα δὲ καὶ χὴν καὶ λάρος καὶ καταρράκτης καὶ ὠτὶς τὸν στόμαχον εὐρὺν καὶ πλατὺν ὅλον, καὶ ἄλλοι δὲ πολλοὶ τῶν ὀρνίθων ὁμοίως. ἔνιοι δὲ τῆς κοιλίας αὐτῆς τι ἔχουσιν ὅμοιον προλόβῳ, οἷον ἡ κεγχρῆις. ἔστι δ' ἃ οὐκ ἔχει οὔτε τὸν στόμαχον οὔτε τὸν πρόλοβον εὐρύν, ἀλλὰ τὴν κοιλίαν μακράν, ὅσα μικρὰ τῶν ὀρνίθων, οἷον χελιδὼν καὶ στρουθός. ὀλίγοι δ' οὔτε τὸν πρόλοβον ἔχουσιν οὔτε τὸν στόμαχον εὐρύν, ἀλλὰ σφόδρα μακρόν, ὅσοι τὸν αὐχένα μακρὸν ἔχουσιν, οἷον πορφυρίων· σχεδὸν δ' οὗτοι καὶ τὸ περίττωμα ὑγρότερον τῶν ἄλλων προΐενται πάντες. ὁ δ' ὄρτυξ ἰδίως ἔχει ταῦτα πρὸς τοὺς ἄλλους· ἔχει γὰρ καὶ πρόλοβον καὶ πρὸ τῆς γαστρὸς τὸν στόμαχον εὐρὺν καὶ πλάτος ἔχοντα· διέχει δ' ὁ πρόλοβος τοῦ πρὸ τῆς γαστρὸς στομάχου συχνὸν ὡς κατὰ μέγεθος.

Ἔχουσι δὲ καὶ λεπτὸν τὸ ἔντερον οἱ πλεῖστοι καὶ ἁπλοῦν ἀναλυόμενον. τὰς δ' ἀποφυάδας ἔχουσιν οἱ ὄρνιθες, καθάπερ εἴρηται, ὀλίγας, καὶ οὐκ ἄνωθεν ὥσπερ οἱ ἰχθύες, ἀλλὰ κάτωθεν κατὰ τὴν τοῦ

[1] καὶ AC : om. vulg.

phagus, is rather narrow, further on it is broader, and where it joins on to the stomach it is slighter. Most birds have a firm, fleshy stomach (gizzard); inside it there is a strong skin which can be pulled away from the fleshy part. Other birds have no crop, but instead of it their oesophagus is wide and spacious, either the whole way, or in the part which extends to the stomach, *e.g.*, the jackdaw, the raven, and the (carrion) crow. The quail's oesophagus, too, has this wide part at the lower end, and in the goat-poll [a] the lower part is slightly wider; so it is in the little owl. In the duck, the goose, the gull, the swooper, and the great bustard the oesophagus is wide and spacious throughout; and similarly in a great many other birds. In some, a portion of the stomach itself resembles a crop, as, *e.g.*, in the kestrel. There are some which have neither a wide oesophagus nor a wide crop but a long stomach—these are the small birds, *e.g.*, the swallow and the sparrow. A few have neither a crop nor a wide oesophagus, but a very long oesophagus, *viz.*, birds with a long neck, *e.g.*, the purple coot [b]; and practically all of these birds produce a more liquid residue [c] than other birds. In respect of these parts, the quail is exceptional: it has not only a crop, but also its oesophagus is wide and spacious in front of the stomach; and relatively to its size, the crop is quite a long way from the oesophagus where this is in front of the stomach.

Most birds' gut is narrow and simple when straightened out. Birds have few gut-appendages, as has been mentioned, and these are not high up, as in fishes, but low down near the termination of the gut.

[a] See note on 506 a 17.

[b] Mentioned again at 595 a 12. [c] See Notes, §§ 22 ff.

509 a

ἑντέρου τελευτήν. ἔχουσι δ' οὐ πάντες ἀλλ' οἱ πλεῖστοι, οἷον ἀλεκτρυών, πέρδιξ, νῆττα, νυκτικόραξ, λόκαλος,[1] ἀσκάλαφος, χήν, κύκνος, ὠτίς, γλαύξ. ἔχουσι δὲ καὶ τῶν μικρῶν τινές, ἀλλὰ μικρὰ πάμπαν, οἷον στρουθός.

[1] λόκαλος om. AC, secl. Dt.

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[a] Lit., the night-raven. It is described at 597 b 23 ff.

Not all birds have them, but the majority of them do, *e.g.*, the domestic fowl, the partridge, the duck, the long-eared owl,[a] the *lokalos*,[b] the *askalaphos*,[c] the goose, the swan, the great bustard, and the little owl. Some of the small birds, too, have them, but very small ones, *e.g.*, the sparrow.

[b] Otherwise unknown ; but see Thompson, *G.G.B.*², p. 77.
[c] Perhaps a kind of owl.

Γ

509 a

I 27 Περὶ μὲν οὖν τῶν ἄλλων μορίων τῶν ἐντὸς εἴρηται, καὶ πόσα καὶ ποῖ' ἄττα, καὶ τίνας ἔχει πρὸς ἄλληλα διαφοράς· λοιπὸν δὲ περὶ τῶν εἰς τὴν γένεσιν συντελούντων μορίων εἰπεῖν. ταῦτα γὰρ τοῖς μὲν θήλεσι πᾶσιν ἐντός ἐστι, τὰ δὲ τῶν ἀρρένων διαφορὰς ἔχει πλείους.

Τὰ μὲν γὰρ ὅλως τῶν ἐναίμων ζῴων οὐκ ἔχει ὄρχεις, τὰ δ' ἔχει μὲν ἐντὸς δ' ἔχει, καὶ τῶν ἐντὸς ἐχόντων τὰ μὲν πρὸς τῇ ὀσφύϊ ἔχει περὶ τὸν τῶν νεφρῶν τόπον, τὰ δὲ πρὸς τῇ γαστρί, τὰ δ' ἐκτός. καὶ τὸ αἰδοῖον τούτων τοῖς μὲν συνήρτηται πρὸς τὴν
509 b γαστέρα, τοῖς δ' ἀφεῖται καθάπερ καὶ οἱ ὄρχεις· πρὸς δὲ τὴν γαστέρα συνήρτηται ἄλλως τοῖς[1] ἐμπροσθουρητικοῖς καὶ τοῖς ὀπισθουρητικοῖς.

Τῶν μὲν οὖν ἰχθύων οὐδεὶς ὄρχεις ἔχει, οὐδ' εἴ τι ἄλλο ἔχει βράγχια, οὐδὲ τὸ τῶν ὄφεων γένος ἅπαν, οὐδ' ὅλως ἄπουν οὐδέν, ὅσα μὴ ζῳοτοκεῖ ἐν αὑτοῖς. οἱ δ' ὄρνιθες ἔχουσι μὲν ὄρχεις, ἔχουσι δ' ἐντὸς πρὸς τῇ ὀσφύϊ. καὶ τῶν τετραπόδων ὅσα ᾠοτοκεῖ, τὸν αὐτὸν ἔχει τρόπον, οἷον σαύρα καὶ χελώνη καὶ κροκόδειλος, καὶ τῶν ζῳοτόκων ἐχῖνος. τὰ δὲ τῶν ἐντὸς ἐχόντων πρὸς τῇ γαστρὶ ἔχει, οἷον τῶν ἀπό-

[1] τοῖς τ' AC, vulg. : τ' secl. A.-W. : τοῖς ἔμπροσθεν οὐρητικοῖς PD.

BOOK III

I Generative parts:

With one exception we have now discussed all the internal parts: we have stated their sizes, their character, and their mutual differences; and it now remains to speak of the parts which contribute to generation. These parts are internal in all female animals: in males they show numerous differences.

in males;

To begin with, in the blooded animals some males have no testicles; others have them, but internally; and of those which have them internally some have them near the loin in the region of the kidneys, and others near the belly, while yet others have external ones: with some of these the penis is closely attached to the belly; with others it is more freely attached, as indeed are the testicles; and in the case of the closer attachment, this varies as between those animals which are retromingent and those which are the reverse.

Now no fish has testicles, nor has any creature which possesses gills, nor has any of the serpent tribe, nor generally any footless animal that is not internally viviparous. Birds have them, but internally, close to the loin. Similarly with oviparous quadrupeds, *e.g.*, the lizard, the tortoise and the crocodile, and—a viviparous example—the hedgehog. Of those that have them internally placed, some have them situated close to the belly: examples are the dolphin (a foot-

509 b

δων μὲν δελφίς, τῶν δὲ τετραπόδων καὶ ζῳοτόκων ἐλέφας· τὰ δ' ἄλλα φανεροὺς ἔχει.

Ἡ δ' ἐξάρτησις ἡ πρὸς τὴν κοιλίαν καὶ τὸν τόπον τὸν συνεχῆ τίνα διαφορὰν ἔχει, πρότερον εἴρηται· τοῖς μὲν γὰρ ἐκ τοῦ ὄπισθεν συνεχεῖς καὶ οὐκ ἀπηρτημένοι εἰσίν, οἷον τῷ γένει τῷ τῶν ὑῶν, τοῖς δ' ἀπηρτημένοι, καθάπερ τοῖς ἀνθρώποις.

Οἱ μὲν οὖν ἰχθύες ὄρχεις μὲν οὐκ ἔχουσιν, ὥσπερ εἴρηται πρότερον, οὐδ' οἱ ὄφεις· πόρους δὲ δύο ἔχουσιν ἀπὸ τοῦ ὑποζώματος ἠρτημένους ἐφ' ἑκάτερα τῆς ῥάχεως, συνάπτοντας εἰς ἕνα πόρον ἄνωθεν τῆς τοῦ περιττώματος ἐξόδου· τὸ δ' ἄνωθεν λέγομεν τὸ πρὸς τὴν ἄκανθαν. οὗτοι δὲ γίγνονται περὶ τὴν ὥραν τῆς ὀχείας θοροῦ πλήρεις, καὶ θλιβομένων ἐξέρχεται τὸ σπέρμα λευκόν. αὐτοὶ δὲ πρὸς αὐτοὺς ἣν ἔχουσι διαφοράν, ἔκ τε τῶν ἀνατομῶν δεῖ θεωρεῖν καὶ ὕστερον λεχθήσεται ἐν τοῖς περὶ ἕκαστον αὐτῶν ἰδίοις ἀκριβέστερον.

Ὅσα δ' ᾠοτοκεῖ ἢ δίποδα ὄντα ἢ τετράποδα, πάντ' ἔχει ὄρχεις πρὸς τῇ ὀσφύϊ κάτωθεν τοῦ διαζώματος, τὰ μὲν λευκοτέρους τὰ δ' ὠχροτέρους, λεπτοῖς πάμπαν φλεβίοις περιεχομένους. καὶ ἀφ' ἑκατέρου τείνει πόρος συνάπτων εἰς ἕν,[1] καθάπερ καὶ τοῖς ἰχθύσιν, ὑπὲρ τῆς τοῦ περιττώματος ἐξόδου. τοῦτο δ' ἐστιν αἰδοῖον, ὃ τοῖς μὲν μικροῖς ἄδηλον, ἐν δὲ τοῖς μείζοσιν, οἷον ἐν χηνὶ καὶ τοῖς τηλικούτοις, φανερώτερον γίγνεται, ὅταν ἡ ὀχεία πρόσφατος ᾖ.

Οἱ δὲ πόροι καὶ τοῖς ἰχθύσι καὶ τούτοις προσπε-

[1] ἕν AC : ἕνα PD, vulg.

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[a] Passages such as 566 a 15 and *G.A.* 746 a 15 suggest that

less example), and the elephant (a viviparous quadruped). Others have them visible externally.

We have already described the different ways in which these parts are attached to the belly and the adjoining region : *viz.*, that in some animals they are connected closely from the rear and do not hang free, as in the pig tribe ; in others they hang free, as in man.

Fishes, then, do not have testicles, as stated above, nor do serpents. But they have two passages connected to the midriff running to either side of the backbone, and converging into one passage above the outlet for the residue : by " above " I mean towards the spine. Towards the breeding season these passages get filled with the genital fluid, and when they are squeezed the semen (which is white) comes out. Fishes differ from one another in this respect ; these differences should be studied from the *Dissections*,[a] and will be described in greater detail when we discuss each species' peculiarities.

The males of oviparous animals, whether bipeds or quadrupeds, all have testicles, which are close to the loin below the midriff ; some are whitish, some rather pale in colour, and they are entirely covered with fine small blood-vessels. From each a passage extends, and, as in fishes, the two passages converge into one above the outlet for the residue. This is the penis : difficult to detect in the small animals, but in the larger ones (*e.g.*, the goose and creatures of similar size) it becomes more conspicuous when copulation has recently occurred.

The passages in fishes as well as in these oviparous

[a] references to " the dissections " are to an actual treatise so called, now lost. See note on 497 a 32.

509 b

φύκασι πρὸς τῇ ὀσφύϊ ὑποκάτω τῆς κοιλίας, μεταξὺ
35 τῶν ἐντέρων καὶ τῆς[1] μεγάλης φλεβός, ἀφ' ἧς τεί-
νουσι πόροι εἰς ἑκάτερον τῶν ὄρχεων. ὥσπερ δὲ
510 a τοῖς ἰχθύσι περὶ μὲν τὴν ὥραν τῆς ὀχείας θορός τε
φαίνεται ἐνὼν καὶ οἱ πόροι σφόδρα δῆλοι, ὅταν δὲ
παρέλθῃ ἡ ὥρα, ἄδηλοι καὶ οἱ πόροι ἐνίοτε, οὕτω
καὶ τῶν ὀρνίθων οἱ ὄρχεις· πρὶν μὲν ὀχεύειν, οἱ μὲν
μικροὺς οἱ δὲ πάμπαν ἀδήλους ἔχουσιν, ὅταν δ'
5 ὀχεύωσι, σφόδρα μεγάλους ἴσχουσιν. ἐπιδηλότατα
δὲ τοῦτο συμβαίνει ταῖς φάτταις καὶ τοῖς πέρδιξιν,
ὥστ' ἔνιοι οἴονται οὐδ' ἔχειν τοῦ χειμῶνος ὄρχεις
αὐτά.

Τῶν δ' ἐν τῷ ἔμπροσθεν ἐχόντων τοὺς ὄρχεις οἱ
μὲν ἐντὸς ἔχουσι πρὸς τῇ γαστρί, καθάπερ δελφίς,
οἱ δ' ἐκτὸς ἐν τῷ φανερῷ πρὸς τῷ τέλει τῆς γα-
10 στρός. τούτοις δὲ τὰ μὲν ἄλλα ἔχει τὸν αὐτὸν τρό-
πον, διαφέρουσι δ' ὅτι οἱ μὲν αὐτῶν ἔχουσι καθ'
αὑτοὺς τοὺς ὄρχεις, οἱ δ' ἐν τῇ καλουμένῃ ὀσχέᾳ,
ὅσοι ἔξωθεν.[2]

Αὐτοὶ δ' οἱ ὄρχεις ἐν πᾶσι τοῖς πεζοῖς καὶ ζῳο-
τόκοις τόνδ' ἔχουσι τὸν τρόπον. τείνουσιν ἐκ τῆς
15 ἀορτῆς πόροι φλεβικοὶ μέχρι τῆς κεφαλῆς ἑκατέρου
τοῦ ὄρχεως, καὶ ἄλλοι ἀπὸ τῶν νεφρῶν δύο· εἰσὶ δ'
οὗτοι μὲν αἱματώδεις, οἱ δ' ἐκ τῆς ἀορτῆς ἄναιμοι.
ἀπὸ δὲ τῆς κεφαλῆς πρὸς αὐτῷ τῷ ὄρχει πόρος ἐστὶ
πυκνότερος ἐκείνων[3] καὶ νευρωδέστερος, ὃς ἀνα-
κάμπτει πάλιν ἐν ἐσχάτῳ[4] τῷ ὄρχει πρὸς τὴν κε-
20 φαλὴν τοῦ ὄρχεως· ἀπὸ δὲ τῆς κεφαλῆς ἑκατέρας[5]

[1] sic Dt., A.-W. secutus : κοιλίας καὶ τῶν ἐντέρων, μεταξὺ τῆς codd., vulg. [2] 7 τῶν δ' hucusque secl. Dt.
[3] ἐκείνων Dt. : ἐκείνου vulg.
[4] ἐσχάτῳ A.-W., Pi. : ἑκατέρῳ vulg.
[5] ἑκατέρας AC : ἑκάτεροι PD, vulg.

quadrupeds are organically attached to the loin under the stomach, between the guts and the Great Blood-vessel, from which passages run to each of the testicles. And as in fishes, the seminal fluid is seen to be present in them at the breeding season and the passages themselves become very conspicuous, but when the season is over the passages actually become invisible in some cases. And similarly with the testicles of birds. Before copulation, in some birds they are small, in others quite indistinguishable ; but during the period of copulation they are very large indeed. A conspicuous example of this is afforded by the ring-dove and the partridge, with the result that some people suppose these birds have no testicles at all during the winter.

Of those whose testicles are in the front part of the body, in some they are internal near the belly, *e.g.*, the dolphin ; in others they are external and visible, near the lower end of the belly. In most respects these animals exhibit precisely the same arrangement but they differ in this : some have their testicles placed separately by themselves, while others (where they are external) have them enclosed in what is called the scrotum.[a]

The following description may be given of the testicles themselves in all footed viviparous animals. From the Aorta passages of blood-vessel character run to the head of each testicle, and two more from the kidneys : the latter contain blood, the former two contain none. From the head of the testicle alongside it there is a passage stouter and more sinewy than the others, which bends back again at the end of the testicle towards the head of it ; and again from the

[a] This paragraph is considered by Dittmeyer to be an interpolation.

510 a πάλιν εἰς ταὐτὸ συνάπτουσιν εἰς τὸ πρόσθεν ἐπὶ τὸ αἰδοῖον. οἱ δ' ἐπανακάμπτοντες πόροι καὶ οἱ προσκαθήμενοι τοῖς ὄρχεσιν ὑμένι περιειλημμένοι εἰσὶ τῷ αὐτῷ, ὥστε δοκεῖν ἕνα εἶναι πόρον, ἂν μὴ διέλῃ τὸν ὑμένα τις. ὁ μὲν οὖν προσκαθήμενος πόρος ἔτι 25 αἱματῶδες ἔχει τὸ ὑγρόν, ἧττον μέντοι τῶν ἄνω τῶν ἐκ τῆς ἀορτῆς[1]· ἐν δὲ τοῖς ἐπανακάμπτουσιν εἰς τὸν καυλὸν τὸν ἐν τῷ αἰδοίῳ λευκή ἐστιν ἡ ὑγρότης. φέρει δὲ καὶ ἀπὸ τῆς κύστεως πόρος, καὶ συνάπτει ἄνωθεν εἰς τὸν καυλόν· περὶ τοῦτον δ' οἷον κέλυφός ἐστι τὸ καλούμενον αἰδοῖον.

Θεωρείσθω δὲ τὰ εἰρημένα ταῦτα ἐκ τῆς ὑπο- 30 γραφῆς τῆσδε.

τῶν πόρων ἀρχὴ τῶν ἀπὸ τῆς ἀορτῆς, ἐφ' οἷς Α·
κεφαλαὶ τῶν ὄρχεων καὶ οἱ καθήκοντες πόροι, ἐφ' οἷς Κ[2]·
οἱ ἀπὸ τούτων πρὸς τῷ ὄρχει προσκαθήμενοι, ἐφ' οἷς τὰ ΩΩ·
οἱ δ' ἀνακάμπτοντες, ἐν οἷς ἡ ὑγρότης ἡ λευκή, ἐφ' οἷς τὰ ΒΒ·
35 αἰδοῖον Δ, κύστις Ε, ὄρχεις ἐν[3] οἷς τὰ ΨΨ.

510 b Ἀποτεμνομένων δ' ἢ ἀφαιρουμένων τῶν ὄρχεων αὐτῶν ἀνασπῶνται οἱ πόροι ἄνω. διαφθείρουσι δ' οἱ μὲν ἔτι νέων ὄντων τρίψει, οἱ δὲ καὶ ὕστερον ἐκτέμνοντες· συνέβη δ' ἤδη ταῦρον ἐκτμηθέντα καὶ εὐθὺς ἐπιβάντα ὀχεῦσαι καὶ γεννῆσαι.

[1] τῶν ἐκ τῆς ἀορτῆς secl. Dt.
[2] KK Gaza, A.-W., Dt.
[3] ἐφ' Sn., vulg.

head of each testicle the two passages continue until they converge in front at the penis. The passages that bend back and those which lie alongside the testicle are enveloped in one and the same membrane, so that they appear to be just one passage, unless the membrane is cut open. Further, the liquid contained in the passage which lies alongside the testicle is still bloodlike, though less so than in the passages higher up which are connected with the Aorta ; whereas in the passages which bend back towards the canal of the penis the liquid is white in colour. Also from the bladder there runs a passage, which leads into the upper part of the canal ; and round this, like a sheath, is what is called the penis.

These details which we have mentioned should be studied in the accompanying diagram.[a]

A indicates the starting-point of the passages which run from the Aorta.

K indicates the heads of the testicles and the passages which come down into them.

ΩΩ indicates the passages running from the preceding alongside the testicle.

BB indicates the passages which turn back, containing the white-coloured fluid.

Δ indicates the penis, E the bladder, ΨΨ the testicles.

When the testicles themselves are excised or removed, the passages are drawn upwards. People sometimes destroy the testicles in young animals by rubbing, or cut them out later on. A case has been known of a bull immediately after castration serving a cow, copulating, and producing offspring.

[a] See diagram on p. 236.

510 b

Τὰ μὲν οὖν περὶ τοὺς ὄρχεις τοῖς ζῴοις τοῦτον ἔχει τὸν τρόπον.

Αἱ δ' ὑστέραι τῶν ἐχόντων ὑστέρας ζῴων οὔτε τὸν αὐτὸν τρόπον ἔχουσιν οὔθ' ὅμοιαι πάντων εἰσίν, ἀλλὰ διαφέρουσι καὶ τῶν ζῳοτοκούντων πρὸς ἄλληλα καὶ τῶν ᾠοτοκούντων. δίκροαι μὲν οὖν εἰσιν ἁπάντων τῶν πρὸς τοῖς ἄρθροις ἐχόντων τὰς ὑστέρας, καὶ τὸ μὲν αὐτῶν ἐν τοῖς δεξιοῖς μέρεσι, τὸ δ' ἕτερον ἐν τοῖς ἀριστεροῖς ἐστιν· ἡ δ' ἀρχὴ μία καὶ τὸ στόμα ἕν, οἷον καυλὸς σαρκώδης σφόδρα καὶ χονδρώδης τοῖς πλείστοις καὶ μεγίστοις. καλεῖται δὲ τούτων τὸ μὲν ὑστέρα καὶ δελφύς (ὅθεν καὶ ἀδελφοὺς προσαγορεύουσι), μήτρα δ' ὁ καυλὸς καὶ τὸ στόμα τῆς ὑστέρας. ὅσα μὲν οὖν ἐστι ζῳοτόκα, καὶ δίποδα καὶ[1] τετράποδα, τούτων μὲν ἡ ὑστέρα πάντων ἐστὶ κάτω τοῦ ὑποζώματος, οἷον ἀνθρώπῳ καὶ κυνὶ καὶ ὑΐ καὶ ἵππῳ καὶ βοΐ· καὶ τοῖς κερατοφόροις ὁμοίως ταῦτά γ' ἔχει πᾶσιν. ἐπ' ἄκρων δ' αἱ ὑστέραι τῶν καλουμένων κερατίων εἱλιγμὸν ἔχουσιν αἱ τῶν πλείστων.

Τῶν δ' ᾠοτοκούντων εἰς τοὐμφανὲς οὐχ ὁμοίως ἁπάντων ἔχουσιν, ἀλλ' αἱ μὲν τῶν ὀρνίθων πρὸς τῷ ὑποζώματι, αἱ δὲ τῶν ἰχθύων κάτω, καθάπερ αἱ τῶν ζῳοτοκούντων διπόδων καὶ τετραπόδων, πλὴν λεπταὶ καὶ ὑμενώδεις καὶ μακραί,[2] ὥστ' ἐν τοῖς σφόδρα μικροῖς τῶν ἰχθύων δοκεῖν ἑκατέραν ᾠὸν εἶναι ἕν, ὡς δύο ἐχόντων ᾠὰ τῶν ἰχθύων τούτων, ὅσων λέγεται τὸ ᾠὸν εἶναι ψαθυρόν· ἔστι γὰρ οὐχ ἓν ἀλλὰ πολλά, διόπερ διαχεῖται εἰς πολλά.

Ἡ δὲ τῶν ὀρνίθων ὑστέρα κάτωθεν μὲν ἔχει τὸν

[1] καὶ A : ἢ vulg.

[2] μικραί A^1, fortasse recte : cf. 567 a 23 (Dt.).

This completes our description of the testicles in animals.

The uterus is not of identical formation in those animals which possess one, nor is it similar in all; differences are found both among the Vivipara and among the Ovipara. In all animals which have the uterus close to the generative organs the uterus is forked, one fork being towards the right side and the other towards the left; its starting-point, however, is single, and so is its opening, as it were a tube consisting of much flesh and cartilage in most animals and in the largest. One of these parts is called the *hystera* or *delphys* (whence the word for brother, *adelphos*, is derived); the other part, the tube or opening of the uterus, is called the *mētra*. In all two-footed and four-footed Vivipara, the uterus is below the midriff, *e.g.*, man, dog, pig, horse, ox; and similarly in all the horned animals. In most amimals, at the extremities of the so-called *keratia* (horns), the uterus has a convolution. in females.

The uterus is not similarly situated in all those animals which are externally oviparous: thus in birds the uterus is near the diaphragm, in fishes down below, just as in two- and four-footed Vivipara, except that in fishes the uterus is of light structure, membranous and long, with the result that, in very small fishes, each of the two forks appears to be a single egg, and these fishes thus appear to have a pair of eggs: these are the fishes whose egg is described as crumbling.[a] In actuality, each portion is not one egg, but many eggs, and that is why the roe breaks up into numerous pieces.

In birds the uterus in its lower regions has its tubu-

[a] *i.e.*, the roe. *Cf.* 517 b 7.

510 b καυλὸν σαρκώδη καὶ στιφρόν, τὸ δὲ πρὸς τῷ ὑπο-
30 ζώματι ὑμενῶδες καὶ λεπτὸν πάμπαν, ὥστε δόξαι
ἂν ἔξω τῆς ὑστέρας εἶναι τὰ ᾠά. ἐν μὲν οὖν τοῖς
μείζοσι τῶν ὀρνίθων δῆλός ἐστιν ὁ ὑμὴν[1] μᾶλλον,
καὶ φυσώμενος διὰ τοῦ καυλοῦ αἴρεται καὶ κολ-
ποῦται· ἐν δὲ τοῖς μικροῖς ἀδηλότερα πάντα ταῦτα.

Τὸν αὐτὸν δὲ τρόπον ἔχει ἡ ὑστέρα καὶ ἐν τοῖς
35 τετράποσι μὲν τῶν ζῴων ᾠοτόκοις δέ, οἷον χελώνῃ
511 a καὶ σαύρᾳ καὶ βατράχοις καὶ τοῖς ἄλλοις τοῖς τοιού-
τοις· ὁ μὲν γὰρ καυλὸς κάτωθεν εἷς καὶ σαρκωδέ-
στερος, ἡ δὲ σχίσις καὶ τὰ ᾠὰ ἄνω πρὸς τῷ ὑπο-
ζώματι. ὅσα δὲ τῶν ἀπόδων εἰς τὸ φανερὸν μὲν
ζῳοτοκεῖ ἐν αὑτοῖς δ' ᾠοτοκεῖ, οἷον οἵ τε γαλεοὶ
5 καὶ τἆλλα τὰ καλούμενα σελάχη (καλεῖται δὲ σέλα-
χος ὃ ἂν ἄπουν ὂν καὶ βράγχια ἔχον ζῳοτόκον ᾖ),
τούτων δὴ δικρόα μὲν ἡ ὑστέρα, ὁμοίως δὲ καὶ πρὸς
τὸ ὑπόζωμα τείνει κάτωθεν ἀρξαμένη[2] καθάπερ καὶ
τῶν ὀρνίθων, ἔστι[3] δὲ διὰ μέσου τῶν δικρόων [κάτ-
ωθεν ἀρξαμένη] μέχρι πρὸς τὸ ὑπόζωμα στενή,[4] καὶ
10 τὰ ᾠὰ ἐνταῦθα γίγνεται καὶ ἄνω ἐπ' ἀρχῇ[5] τοῦ ὑπο-
ζώματος· εἶτα προελθόντα εἰς τὴν εὐρυχωρίαν ζῷα
γίγνεται ἐκ τῶν ᾠῶν. αὐτῶν δὲ τούτων πρὸς ἄλ-
ληλά τε καὶ πρὸς τοὺς ἄλλους ἰχθῦς ἡ διαφορὰ τῶν
ὑστερῶν ἀκριβέστερον ἂν θεωρηθείη τοῖς σχήμασιν
ἐκ τῶν ἀνατομῶν.

Ἔχει δὲ καὶ τὸ τῶν ὄφεων γένος πρός τε ταῦτα
15 καὶ πρὸς ἄλληλα διαφοράν. τὰ μὲν γὰρ ἄλλα γένη
τῶν ὄφεων ᾠοτοκεῖ πάντα, ὁ δ' ἔχις[6] ζῳοτοκεῖ μό-
νον, ᾠοτοκήσας ἐν αὑτῷ πρῶτον· διὸ παραπλησίως

[1] ὁ ὑμὴν ἐστι PD, vulg.
[2] κάτωθεν ἀρξαμένη huc ex v. 8 transtul. Sn., Pi.
[3] Pi. : ἔτι vulg. [4] Pi. : τείνει vulg.

lar part fleshy and firm, and the part which is close to the diaphragm membranous and very fine, to such a degree that the eggs might well seem to be right outside the uterus. In the larger birds the membrane is more clearly visible, and when it is inflated through the tube it rises and swells out ; in the smaller birds all these parts are less clearly seen.

The disposition of the uterus is similar to this in the oviparous quadrupeds, *e.g.*, the tortoise, the lizard, the frog, and the like ; the tube down below is single and tends to be fleshy, and the divided part and the eggs are up at the top close to the diaphragm. In those footless animals which are externally viviparous though internally oviparous, *e.g.*, the dogfish and the other Selachia as they are called (a term which denotes any footless creature which has gills and is viviparous), the uterus is forked and similarly it begins down below and extends as far as the midriff, as with birds. In between the two portions of the bifurcation it is narrow as far as the diaphragm ; and the eggs are produced here and above at the starting-point of the diaphragm ; afterwards they advance into the wider part and the young hatch out of them. But the differences to be observed in the uterus as among these fishes and also when compared with the other fishes can be more precisely studied in their various formations from the *Dissections*.

The serpent tribe also shows differences, both compared with the animals just mentioned and within itself. All kinds of serpents are oviparous, except the viper, which is the only viviparous serpent, though it has a previous stage of being internally oviparous,

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[5] ἀρχῇ Bk. per typoth. errorem.
[6] ἔχις AC : ἔχις δὲ PD, vulg., omisso πάντα, ὁ.

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ἔχει τὰ περὶ τὴν ὑστέραν τοῖς σελάχεσιν. ἡ δὲ τῶν ὄφεων ὑστέρα μακράν,[1] καθάπερ τὸ σῶμα, τείνει, κάτωθεν ἀρξαμένη ἀφ' ἑνὸς πόρου, συνεχὴς ἔνθεν καὶ ἔνθεν τῆς ἀκάνθης, οἷον πόρος ἑκατέρωθεν,[2] μέχρι πρὸς τὸ ὑπόζωμα, ἐν ᾗ τὰ ᾠὰ κατὰ στοῖχον ἐγγίγνεται, καὶ ἐκτίκτει οὐ καθ' ἓν ἀλλὰ συνεχές. [ἔχει δὲ τὴν ὑστέραν, ὅσα μὲν ζωοτοκεῖ καὶ ἐν αὑτοῖς καὶ εἰς τοὐμφανές, ἄνωθεν τῆς κοιλίας, ὅσα δ' ᾠοτοκεῖ, πάντα κάτωθεν πρὸς τῇ ὀσφύϊ. ὅσα δ' εἰς τὸ φανερὸν μὲν ζωοτοκεῖ ἐν αὑτοῖς δ' ᾠοτοκεῖ, ἐπαμφοτερίζει· τὸ μὲν γὰρ κάτωθεν πρὸς τὴν ὀσφὺν αὐτῆς μέρος ἐστίν, ἐν ᾧ τὰ ᾠά, τὸ δὲ περὶ τὴν ἔξοδον ἐπάνω τῶν ἐντέρων.][3]

Ἔτι δὲ διαφορὰ καὶ ἥδε πρὸς ἀλλήλας ἐστὶ τῶν ὑστερῶν. τὰ μὲν γὰρ κερατοφόρα καὶ μὴ ἀμφώδοντα ἔχει κοτυληδόνας ἐν τῇ ὑστέρᾳ, ὅταν ἔχῃ τὸ ἔμβρυον, καὶ τῶν ἀμφωδόντων οἷον δασύπους καὶ μῦς καὶ νυκτερίς· τὰ δ' ἄλλα τὰ ἀμφώδοντα καὶ ζωοτόκα καὶ ὑπόποδα πάντα λείαν ἔχει τὴν ὑστέραν, καὶ ἡ τῶν ἐμβρύων ἐξάρτησις ἐξ αὐτῆς ἐστι τῆς ὑστέρας, ἀλλ' οὐκ ἐκ κοτυληδόνος.

Τὰ μὲν οὖν ἀνομοιομερῆ ἐν τοῖς ζῴοις μέρη τοῦτον ἔχει τὸν τρόπον, καὶ τὰ ἐκτὸς καὶ τὰ ἐντός.

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II Τῶν δ' ὁμοιομερῶν κοινότατον μέν ἐστι τὸ αἷμα πᾶσι τοῖς ἐναίμοις ζῴοις καὶ τὸ μόριον ἐν ᾧ πέφυκεν ἐγγίγνεσθαι (τοῦτο δὲ καλεῖται φλέψ), ἔπειτα δὲ

[1] μακράν Warmington : μακρά vulg.
[2] <χωρὶς> ἑκατέρωθεν Pi. : ἑκάτερος ὤν vulg.
[3] secl. Sn., Dt.

and for this reason its uterus is similar to that of Selachia. The uterus of the serpents, like these creatures' whole body, reaches a long way, and beginning below from a single passage it extends continuously on either side of the spine, as though there were a passage on each side, until it reaches the diaphragm ; and here the eggs are formed, in a row ; and they are laid, not one by one, but all adhering together. [Those animals which are viviparous both internally and externally have the uterus situated above the stomach ; those which are oviparous all have it below, near the loin. Those which are externally viviparous but internally oviparous are dualizers [a] : the lower part of the uterus (where the eggs are) is near the loin ; the part round the outlet is above the gut.] [b]

Here is a further point of difference when one uterus is compared with another. The horned non-ambidentate animals have cotyledons in the uterus when they are pregnant ; so have such ambidentate animals as the hare, the mouse and the bat. The other animals, ambidentate, viviparous, and footed, all have a smooth uterus, and the attachment of the embryo is to the uterus itself, and not to any cotyledon.

Such then is the nature of the non-uniform parts, both the external and the internal ones, which are found in animals.

II THE UNIFORM PARTS.

We go on now to the uniform parts.[c] The most universal of these in all blooded animals is the blood, and the part wherein the blood has its natural place, *viz.*, the blood-vessel. Next come the counterparts of

[a] See note on 488 a 2, and Notes, §§ 28 ff.

[b] This passage is considered by Schneider and Dittmeyer to be an interpolation.

[c] See Notes, § 1.

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τὰ[1] ἀνάλογον τούτοις, ἰχὼρ καὶ ἶνες, καὶ ὃ μάλιστα δή ἐστι τὸ σῶμα τῶν ζῴων, ἡ σὰρξ καὶ τὸ τούτῳ ἀνάλογον ἐν ἑκάστῳ μόριον, ἔτι ὀστοῦν καὶ τὸ ἀνάλογον τούτῳ, οἷον ἄκανθα καὶ χόνδρος· ἔτι δὲ δέρμα, ὑμήν, νεῦρα, τρίχες, ὄνυχες, καὶ τὰ ὁμολογούμενα τούτοις· πρὸς δὲ τούτοις πιμελή, στέαρ καὶ τὰ περιττώματα· ταῦτα δ' ἐστὶ κόπρος, φλέγμα, χολὴ ξανθὴ καὶ μέλαινα.

Ἐπεὶ δ' ἀρχῇ ἔοικεν ἡ τοῦ αἵματος φύσις καὶ ἡ τῶν φλεβῶν, πρῶτον περὶ τούτων λεκτέον, ἄλλως τ' ἐπειδὴ καὶ τῶν πρότερον εἰρηκότων τινὲς οὐ καλῶς λέγουσιν. αἴτιον δὲ τῆς ἀγνοίας τὸ δυσθεώρητον αὐτῶν. ἐν μὲν γὰρ τοῖς τεθνεῶσι τῶν ζῴων ἄδηλος ἡ φύσις τῶν κυριωτάτων φλεβῶν διὰ τὸ συμπίπτειν εὐθὺς ἐξίοντος τοῦ αἵματος μάλιστα ταύτας (ἐκ τούτων γὰρ ἐκχεῖται ἀθρόον ὥσπερ ἐξ ἀγγείου· καθ' αὑτὸ γὰρ οὐδὲν ἔχει αἷμα, πλὴν ὀλίγον ἐν τῇ καρδίᾳ, ἀλλὰ πᾶν ἐστιν ἐν ταῖς φλεψίν), ἐν δὲ τοῖς ζῶσιν ἀδύνατόν ἐστι θεάσασθαι πῶς ἔχουσιν· ἐντὸς γὰρ ἡ φύσις αὐτῶν. ὥσθ' οἱ μὲν ἐν τεθνεῶσι καὶ διῃρημένοις τοῖς ζῴοις θεωροῦντες τὰς μεγίστας ἀρχὰς οὐκ ἐθεώρουν, οἱ δ' ἐν τοῖς λελεπτυσμένοις σφόδρα ἀνθρώποις ἐκ τῶν τότε ἔξωθεν φαινομένων τὰς ἀρχὰς τῶν φλεβῶν διώρισαν. Συένεσις μὲν ⟨γὰρ⟩[2] ὁ Κύπριος ἰατρὸς τόνδε τὸν τρόπον

[1] τὰ Peck : τὸ vulg. ; cf. 487 a 5.
[2] ⟨γὰρ⟩ Pi.

[a] See note on 489 a 23.

these, ichor and fibres [a]; and that which *par excellence* constitutes the bodies of animals, *viz.*, flesh and the counterpart [b] of it in each animal; then bone and its counterparts, such as fish-spine and cartilage; also skin, membrane, sinew, hair, nails, and the substances which correspond to these; and in addition, fat, suet, and the residues [c] (dung, phlegm, yellow and black bile).

Blood and blood-vessels.

Now, since blood and blood-vessels, as natural substances, give the impression of being fundamental,[d] we must discuss them first, especially in view of the fact that some earlier writers have not given satisfactory accounts of them. Their mistakes were due to the difficulties of observation. In dead animals the nature of the most important blood-vessels cannot be discovered because they above all else collapse immediately as soon as the blood goes out of them: the blood pours out of them all at once as though out of a vessel (since no part of the body possesses blood loose, as it were, except that there is a little in the heart—all of it is in the blood-vessels). And in living animals it is impossible to inspect the blood-vessels to ascertain their nature, because they are internal. Consequently, those who have inspected dead and dissected animals have failed to observe the main sources ⟨of the blood-vessels⟩, while those who have examined extremely emaciated patients have drawn their conclusions about the sources of the blood-vessels from what could then be seen externally. For Syennesis. instance, Syennesis, the physician of Cyprus, writes

[b] See Notes, §§ 3 f.

[c] See Notes, §§ 22 ff.

[d] Or, "are pretty clearly a first principle." See Notes, § 12, and *cf.* 520 b 10 below: "blood is an indispensable part."

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λέγει.[1]

Αἱ φλέβες αἱ παχεῖαι ὧδε πεφύκασιν· ἐκ τοῦ ὀφθαλμοῦ[2] παρὰ τὴν ὀφρὺν[3] διὰ τοῦ νώτου παρὰ τὸν πνεύμονα ὑπὸ τοὺς μαστούς, ἡ μὲν ἐκ τοῦ δεξιοῦ εἰς τὰ ἀριστερά, ἡ δ' ἐκ τοῦ ἀριστεροῦ εἰς τὸ δεξιόν. ἡ μὲν οὖν ἐκ τοῦ ἀριστεροῦ διὰ τοῦ ἥπατος εἰς τὸν νεφρὸν καὶ εἰς τὸν ὄρχιν, ἡ δ' ἐκ τοῦ δεξιοῦ εἰς τὸν σπλῆνα καὶ νεφρὸν καὶ ὄρχιν, ἐντεῦθεν δ' εἰς τὸ αἰδοῖον.

Διογένης δ' ὁ Ἀπολλωνιάτης τάδε λέγει·

Αἱ φλέβες ἐν τῷ ἀνθρώπῳ ὧδ' ἔχουσιν. εἰσὶ δύο μέγισται· αὗται τείνουσι διὰ τῆς κοιλίας παρὰ τὴν νωτιαίαν ἄκανθαν, ἡ μὲν ἐπὶ δεξιὰ ἡ δ' ἐπ' ἀριστερά, εἰς τὰ σκέλη, ἑκατέρα ⟨εἰς τὸ⟩[4] παρ' ἑαυτῇ, καὶ ἄνω εἰς τὴν κεφαλὴν παρὰ τὰς κλεῖδας
512 a διὰ τῶν σφαγῶν. ἀπὸ δὲ τούτων καθ' ἅπαν τὸ σῶμα φλέβες διατείνουσιν, ἀπὸ μὲν τῆς δεξιᾶς εἰς τὰ δεξιά, ἀπὸ δὲ τῆς ἀριστερᾶς εἰς τὰ ἀριστερά, μέγισται μὲν δύο εἰς τὴν καρδίαν περὶ αὐτὴν τὴν νωτιαίαν ἄκανθαν, ἕτεραι δ' ὀλίγον ἀνωτέρω διὰ τῶν στηθῶν ὑπὸ τὴν μασχάλην εἰς ἑκατέραν τὴν χεῖρα τὴν παρ' ἑαυτῇ· καὶ καλεῖται ἡ μὲν σπληνῖτις, ἡ δ' ἡπατῖτις. σχίζεται δ' αὐτῶν ἄκρα ἑκατέρα, ἡ μὲν ἐπὶ τὸν μέγαν δάκτυλον, ἡ δ' ἐπὶ

[1] λέγει AC : *dicens* Σ : om. PD, vulg.

[2] ὀφθαλμοῦ PD, text. Hipp., Pi., Dt. : *ex parte oculorum et superciliorum* Σ : ὀμφαλοῦ AC, vulg., Th.

[3] ὀφρὺν PCDA[1], text. Hipp., Pi., Dt., Σ : ὀσφὺν A[2], vulg., Th. exinde Σ *et procedunt ad partes colli, deinde ad dorsum*, etc.

[4] ⟨εἰς τὸ⟩ A.-W. : τὰ D, vulg., om. PCA[2].

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[a] This passage, with an addition, occurs also in the Hippo-

as follows [a] :

The nature of the stout blood-vessels is this : from the eye across the eyebrow,[b] along the back, past the lung, below the breasts ; one runs from right to left, the other from left to right : the latter runs through the liver to the kidney and the testicle, the former to the spleen and kidney and testicle, and thence to the penis.

Diogenes [c] of Apollonia gives the following account: Diogenes.

The blood-vessels in man are as follows : There are two which are outstanding in size, and these extend through the belly along the backbone, one to the right, the other to the left, each to the leg on its own side of the body, and upwards to the head past the collar bones through the throat. From these two, blood-vessels extend all over the body : from the right-hand blood-vessel to the right side, and from the left-hand blood-vessel to the left side ; of which the most important are two which run to the heart near the backbone, and two others which run slightly higher up through the chest under the armpits, each to the hand on its own side of the body : one of these is called the splenetic, the other the hepatic. Each of them splits into two at its extremity, one branch going to the thumb,

cratic treatise *de natura ossium*, ch. 8 (ix. 174 L.) ; *cf.* also Littré i. 419 f.

[b] Another reading is " from the navel across the loin." The Hippocratic text agrees with that given opposite.

[c] Diogenes of Apollonia, " the last of the Presocratics," *floruit c.* 440–430 B.C. This passage is not known elsewhere, but a statement in Simplicius (*Phys.* 153. 15) seems to suggest that it came in his book on *Nature* (περὶ Φύσεως). It is, no doubt, the " precise anatomy of the blood-vessels " which Simplicius says Diogenes gave.

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τὸν ταρσόν· ἀπὸ δὲ τούτων λεπταὶ καὶ πολύοζοι ἐπὶ τὴν ἄλλην χεῖρα καὶ δακτύλους. ἕτεραι δὲ λεπτότεραι ἀπὸ τῶν πρώτων φλεβῶν τείνουσιν, ἀπὸ μὲν τῆς δεξιᾶς εἰς τὸ ἧπαρ ἀπὸ δὲ τῆς ἀριστερᾶς εἰς τὸν σπλῆνα καὶ τοὺς νεφρούς. αἱ δ' εἰς τὰ σκέλη τείνουσαι σχίζονται κατὰ τὴν πρόσφυσιν,[1] καὶ διὰ παντὸς τοῦ μηροῦ τείνουσιν. ἡ δὲ μεγίστη αὐτῶν ὄπισθεν τείνει τοῦ μηροῦ, καὶ ἐκφαίνεται παχεῖα· ἑτέρα δ' εἴσω τοῦ μηροῦ, μικρὸν ἧττον παχεῖα ἐκείνης. ἔπειτα παρὰ τὸ γόνυ τείνουσιν εἰς τὴν κνήμην τε καὶ τὸν πόδα, καθάπερ αἱ[2] εἰς τὰς χεῖρας· καὶ ἐπὶ τὸν ταρσὸν τοῦ ποδὸς καθήκουσι, καὶ ἐντεῦθεν ἐπὶ τοὺς δακτύλους διατείνουσιν. σχίζονται δὲ καὶ ἐπὶ τὴν κοιλίαν καὶ τὸ πλευρὸν πολλαὶ ἀπ' αὐτῶν καὶ λεπταὶ φλέβες.

Αἱ δ' εἰς τὴν κεφαλὴν τείνουσαι διὰ τῶν σφαγῶν φαίνονται ἐν τῷ αὐχένι μεγάλαι· ἀφ' ἑκατέρας δ' αὐτῶν, ᾗ τελευτᾷ, σχίζονται εἰς τὴν κεφαλὴν πολλαί, αἱ μὲν ἐκ τῶν δεξιῶν εἰς τὰ ἀριστερά, αἱ δ' ἐκ τῶν ἀριστερῶν εἰς τὰ δεξιά· τελευτῶσι δὲ παρὰ τὸ οὖς ἑκάτεραι. ἔστι δ' ἑτέρα φλὲψ ἐν τῷ τραχήλῳ παρὰ τὴν μεγάλην ἑκατέρωθεν, ἐλάττων ἐκείνης ὀλίγον, εἰς ἣν αἱ πλεῖσται ἐκ τῆς κεφαλῆς συνέχουσιν αὐτῆς· καὶ αὗται τείνουσιν διὰ τῶν σφαγῶν εἴσω. καὶ ἀπ' αὐτῶν ἑκατέρας ὑπὸ τὴν ὠμοπλάτην τείνουσι καὶ εἰς τὰς χεῖρας, καὶ φαίνονται παρά τε τὴν σπληνῖτιν καὶ

[1] ὀσφύν coni. A.-W. : *separantur a radicibus coxe* Σ.
[2] αἱ C : καὶ vulg. : om. A (καὶ καθάπερ A.-W.).

the other to the palm of the hand ; and a number of tiny blood-vessels, much branched, lead off from them to the fingers and the rest of the hand. Other blood-vessels, tinier still, lead off from the principal ones : from the blood-vessel on the right, to the liver, from that on the left, to the spleen and the kidney. Those blood-vessels which run to the legs fork into two at the junction of the legs and trunk, and extend the whole length of the thigh. The largest of them runs down the thigh at the rear, and can readily be seen as a stout one ; the other runs inside the thigh, and is slightly less stout than the first. After that they continue past the knee to the shin and the foot, just like those which run to the hands, and ultimately reach the sole of the foot, whence they ramify to the toes. There are also numerous small blood-vessels which split off from the great blood-vessels towards the stomach and the ribs.

The blood-vessels which run to the head through the throat can be seen as large ones in the neck ; and from each of the two, at the point where it terminates, a number of blood-vessels branch off to the head, some from the right towards the left, some from the left towards the right ; and each set finishes up beside the ear. There is another blood-vessel in the neck running beside the large one on either side : each of these is slightly smaller than the large one which it accompanies, and to it most of the blood-vessels from the head are connected. These two run through the throat inside. From each of them blood-vessels extend below the shoulder-blades and towards the hands and can be observed alongside the splenetic and hepatic as

512 a

τὴν ἡπατῖτιν ἕτεραι ὀλίγον ἐλάττους, ἃς ἀποσχάζουσιν,[1] ὅταν τι ὑπὸ τὸ δέρμα λυπῇ· ἐὰν δέ τι περὶ τὴν κοιλίαν, τὴν ἡπατῖτιν καὶ τὴν σπληνῖτιν. τείνουσι δὲ καὶ ὑπὸ τοὺς μαστοὺς ἀπὸ τούτων
512 b ἕτεραι.

Ἕτεραι δ' εἰσὶν αἱ ἀπὸ ἑκατέρας τείνουσαι διὰ τοῦ νωτιαίου μυελοῦ εἰς τοὺς ὄρχεις, λεπταί. ἕτεραι δ' ὑπὸ τὸ δέρμα καὶ διὰ τῆς σαρκὸς τείνουσιν εἰς τοὺς νεφρούς, καὶ τελευτῶσιν εἰς τοὺς ὄρχεις τοῖς ἀνδράσι, ταῖς δὲ γυναιξὶν εἰς τὰς
5 ὑστέρας· αὗται δὲ σπερματίτιδες καλοῦνται.[2] αἱ δὲ φλέβες αἱ μὲν πρῶται ἐκ τῆς κοιλίας εὐρύτεραί εἰσιν, ἔπειτα λεπτότεραι γίγνονται, ἕως ἂν μεταβάλωσιν ἐκ τῶν δεξιῶν εἰς τὰ ἀριστερὰ καὶ ἐκ τούτων εἰς τὰ δεξιά.

Τὸ δ' αἷμα τὸ μὲν παχύτατον ὑπὸ τῶν σαρκῶν
10 ἐκπίνεται[3]· ὑπερβάλλον δ' εἰς τοὺς τόπους τούτους λεπτὸν καὶ θερμὸν καὶ ἀφρῶδες γίγνεται.

III Συέννεσις μὲν οὖν καὶ Διογένης οὕτως εἰρήκασιν, Πόλυβος δ' ὧδε·

[Τὰ δὲ][4] τῶν φλεβῶν τέτταρα ζεύγη ἐστίν, ἓν μὲν ἀπὸ τοῦ ἐξόπισθεν τῆς κεφαλῆς διὰ τοῦ αὐχένος
15 ἔξωθεν παρὰ τὴν ῥάχιν ἔνθεν καὶ ἔνθεν μέχρι τῶν ἰσχίων εἰς τὰ σκέλη, ἔπειτα διὰ τῶν κνημῶν ἐπὶ τῶν σφυρῶν τὰ ἔξω[5] καὶ εἰς τοὺς πόδας· διὸ καὶ

[1] ἀποσχῶσιν D, vulg.: ἀπο(ὑπο- A)σχίζουσιν καὶ (καὶ om. A) αἱ ὑπερέχουσαι C.

[2] haec iv verba huc transtulit Th., suadente Dt.; post v. 8 δεξιά codd., vulg.

[3] ἐκπίνεται PD: *imbibitur et suggitur a carne* Σ: ἐγγί-(γ)νεται AC, vulg.

[4] secl. Dt.

another pair slightly smaller in size. These are the vessels which surgeons lance when any pain is felt below the surface of the skin ; but when any pain is felt in the region of the stomach it is the hepatic and the splenetic which are lanced. From these, other blood-vessels run below the breasts.

There is yet another pair, which run on each side through the spinal marrow to the testicles ; these are thin ones. Another pair runs just below the skin through the flesh to the kidneys ; and in men these terminate at the testicles, in women, at the uterus. These are known as the spermatic blood-vessels. The blood-vessels which run from the stomach are at first fairly broad, but become narrower as they proceed, until they change over from right to left and from left to right.

The thickest of the blood is drawn off by the fleshy parts of the body ; the overflow which passes into the regions just mentioned becomes thin, hot, and frothy.

Such are the accounts given by Syennesis and Diogenes. Here is Polybus's [a] account : III Polybus.

There are four pairs of blood-vessels. One pair runs from the back of the head through the neck on the outside past the backbone on either side till it reaches the loins and so to the legs, and after that through the shins to the outer part of the ankles

[a] Polybus, *alias* Polybius, the pupil and son-in-law of Hippocrates : " Polybius, his [*i.e.* Hippocrates's] daughter's husband," Hipp. ix. 420 L. This passage, with a continuation not quoted by Aristotle, occurs also in the two Hippocratic treatises *de natura ossium*, ch. 9 (ix. 174-176 L.) and *de natura hominis*, ch. 11 (vi. 58-60 L.).

[5] sic text. Hipp., Dt. : codd. varia.

512 b

τὰς φλεβοτομίας ποιοῦνται τῶν περὶ τὸν νῶτον ἀλγημάτων καὶ ἰσχίον ἀπὸ[1] τῶν ἰγνύων καὶ τῶν σφυρῶν ἔξωθεν.[2] ἕτεραι δὲ φλέβες ἐκ τῆς κεφαλῆς παρὰ τὰ ὦτα διὰ τοῦ αὐχένος, αἳ καλοῦνται σφαγίτιδες, ἔνδοθεν παρὰ τὴν ῥάχιν ἑκάτεραι φέρουσι[3] παρὰ τὰς ψύας[4] εἰς τοὺς ὄρχεις καὶ εἰς τοὺς μηρούς, καὶ διὰ τῶν ἰγνύων τοῦ ἔνδοθεν μορίου καὶ διὰ τῶν κνημῶν ἐπὶ τὰ σφυρὰ τὰ εἴσω καὶ τοὺς πόδας· διὸ καὶ τὰς φλεβοτομίας ποιοῦνται τῶν περὶ τὰς ψύας[5] καὶ τοὺς ὄρχεις ἀλγημάτων ἀπὸ τῶν ἰγνύων καὶ τῶν σφυρῶν ⟨εἴσωθεν⟩.[6] τὸ δὲ τρίτον ζεῦγος ἐκ τῶν κροτάφων διὰ τοῦ αὐχένος ὑπὸ τὰς ὠμοπλάτας εἰς τὸν πνεύμονα ἀφικοῦνται, ἡ[7] μὲν ἐκ τῶν δεξιῶν εἰς τὰ ἀριστερὰ ὑπὸ τὸν μαστὸν καὶ εἰς τὸν σπλῆνά τε καὶ εἰς τὸν νεφρόν, ἡ δ' ἀπὸ τῶν ἀριστερῶν εἰς τὰ δεξιὰ[8] ἐκ τοῦ πνεύμονος ὑπὸ τὸν μαστὸν καὶ ⟨εἰς τὸ⟩[9] ἧπαρ καὶ εἰς τὸν νεφρόν· ἄμφω δὲ τελευτῶσιν εἰς τὸν ἀρχόν.[10] αἱ δὲ τέταρται ἀπὸ τοῦ ἔμπροσθεν τῆς

513 a κεφαλῆς καὶ τῶν ὀφθαλμῶν ὑπὸ τὸν αὐχένα καὶ τὰς κλεῖδας[11]· ἐντεῦθεν δὲ τείνουσι διὰ τῶν βραχιόνων ἄνωθεν εἰς τὰς καμπάς, εἶτα διὰ τῶν πήχεων ἐπὶ τοὺς καρποὺς καὶ τὰς συγκαμπάς, καὶ διὰ τῶν βραχιόνων τοῦ κάτωθεν μορίου εἰς τὰς μασχάλας, καὶ ἐπὶ τῶν πλευρῶν[12] ἄνωθεν, ἕως ἡ μὲν ἐπὶ τὸν σπλῆνα ἡ δ' ἐπὶ τὸ ἧπαρ ἀφίκηται·

[1] μεταξὺ vel ἐντὸς loco ἀπὸ velit Dt.
[2] sic AC, text. Hipp. : τῶν ἐξ. σφ. P, vulg.
[3] sic PD, text. Hipp. : φέρουσαι AC, vulg.
[4] ψύας A, text. Hipp. : ψοιὰς PD, vulg.

and to the feet. That is why surgeons make incisions in the hams and outer parts of the ankles to relieve pains in the back and loin. Another pair of blood-vessels runs from the head past the ears, through the neck : these are called the jugular veins. They continue inside along the backbone, past the loin-muscles to the testicles and to the thighs, and through the inner part of the hams and through the shins to the inside of the ankles and to the feet ; and that is why surgeons make incisions in the hams and ⟨inner side of⟩ the ankles for pains in the loin-muscles and testicles. The third pair runs from the temples through the neck under the shoulder-blades till they reach the lung : the one from the right going to the left under the breast and on to the spleen and kidney ; the one from the left going to the right from the lung under the breast and to the liver and kidney : both terminate at the rectum. The fourth pair runs from the front of the head and the eyes underneath the neck and the collar-bones ; from there they extend from above through the upper part of the arms to the elbows, then through the forearms to the wrists and the joints at the base of the fingers, and also through the lower part of the upper arms to the armpits, and keeping above the ribs, until one of them reaches the spleen and the other reaches the liver ;

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[5] *ψυὰς* AC, *ψοιὰς* PD, vulg.
[6] suppl. Dt. e text. Hipp.
[7] *ἡ . . . ἡ* text. Hipp. : *αἱ . . . αἱ* vulg.
[8] *τὰ δεξιὰ* text. Hipp., Pi. : *τὸν δεξιὸν* vulg.
[9] add. Pi. e text. Hipp.
[10] *ἀρχόν* AC, text. Hipp. : *ὄρχιν* PD, vulg.
[11] *κλεῖδας* AC : *κληῖδας* text. Hipp. : *κλεῖς* PD, vulg.
[12] ⟨*τὸ*⟩ add. Dt.

513 a

εἶθ' ὑπὲρ τῆς γαστρὸς εἰς τὸ αἰδοῖον ἄμφω τελευτῶσιν.

Τὰ μὲν οὖν ὑπὸ τῶν ἄλλων εἰρημένα σχεδὸν ταῦτ' ἐστίν· εἰσὶ δὲ καὶ τῶν περὶ φύσιν οἳ τοιαύτην μὲν οὐκ ἐπραγματεύθησαν ἀκριβολογίαν περὶ τὰς φλέβας, πάντες δ' ὁμοίως τὴν ἀρχὴν αὐτῶν ἐκ τῆς κεφαλῆς καὶ τοῦ ἐγκεφάλου ποιοῦσι, λέγοντες οὐ καλῶς. χαλεπῆς δ' οὔσης, ὥσπερ εἴρηται πρότερον,[1] τῆς θεωρίας ἐν μόνοις τοῖς ἀποπεπνιγμένοις τῶν ζῴων προλεπτυνθεῖσιν ἔστιν ἱκανῶς καταμαθεῖν, εἴ τινι περὶ τῶν τοιούτων ἐπιμελές.

Ἔχει δὲ τοῦτον τὸν τρόπον ἡ τῶν φλεβῶν φύσις. δύο φλέβες εἰσὶν ἐν τῷ θώρακι κατὰ τὴν ῥάχιν ἐντός, ἔστι δὲ κειμένη αὐτῶν ἡ μὲν μείζων ἐν τοῖς ἔμπροσθεν, ἡ δ' ἐλάττων ὄπισθεν ταύτης, καὶ ἡ μὲν μείζων ἐν τοῖς δεξιοῖς μᾶλλον, ἡ δ' ἐλάττων ἐν τοῖς ἀριστεροῖς, ἣν καλοῦσί τινες ἀορτὴν ἐκ τοῦ τεθεᾶσθαι καὶ ἐν τοῖς τεθνεῶσιν τὸ νευρῶδες[2] αὐτῆς μόριον. αὗται δ' ἔχουσι τὰς ἀρχὰς ἀπὸ τῆς καρδίας· διὰ μὲν γὰρ τῶν ἄλλων σπλάγχνων, ἧ τυγχάνουσι τείνουσαι, ὅλαι δι' αὐτῶν διέρχονται σωζόμεναι καὶ οὖσαι φλέβες, ἡ δὲ καρδία ὥσπερ μόριον αὐτῶν ἐστι, καὶ μᾶλλον τῆς ἐμπροσθίας καὶ μείζονος, διὰ

[1] πρότερον om. PD, vulg.

[2] τὸ νευρῶδες vulg., edd.: *partem quae est in eo ex nervo* Σ: ἀερῶδες coni. Th.

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[a] It is not clear that this view is expressed in Diogenes's account. Littré (i. 220) thought that all Hippocratic treatises which assign the origin of the blood-vessels to the heart were of later date than Aristotle. In Plato, *Timaeus* 70 B, however,

then, passing over the stomach, they both terminate at the penis.

Aristotle's comments,

These passages give a pretty fair idea of what other writers have said. There are, too, some workers on the subject of Nature who have not gone into the subject of the blood-vessels with such precision. All alike, however, specify the source of them as being in the head or brain [a]; and this assertion is mistaken. Now since, as I said before, observation is difficult, it is only in strangled animals which have been previously emaciated that it is possible adequately to discover the facts, if one makes the subject one's business.[b]

and his own account.

Actually the natural scheme of the blood-vessels is as follows: There are two blood-vessels in the thorax beside the backbone, on the inside, and the larger of the two is placed in front, and the smaller behind it. The larger is rather over to the right side of the body, and the smaller to the left, and this one some call the Aorta because even in dead bodies they have observed the sinewy part of it.[c] These blood-vessels have their starting-point in the heart, as is shown by the fact that whatever other viscera they happen to go through on their course, they pass through them intact, retaining their character of blood-vessels, whereas the heart is as it were a part of them, and especially of the front one (the large one), because these two

the heart is described as "the tie of the blood-vessels and the fountain-spring of the blood which runs round through all the limbs."

[b] This is Aristotle's method in contrast with the methods described at 496 b 5 ff. and 511 b 15 ff; *cf.* 515 b 1 ff.

[c] For τὸ νευρῶδες Thompson conjectures ἀερῶδες, "they have seen part of it to be full of air"; but this seems inappropriate, because (*a*) "Aorta" means, literally, "hanger," "suspender," "strap," and (*b*) Aristotle insists on the sinewy nature of the Aorta; see, *e.g.*, 513 b 9, 514 b 23, 515 a 30.

513 a τὸ ἄνω μὲν καὶ κάτω τὰς φλέβας εἶναι ταύτας, ἐν μέσῳ δ' αὐτῶν τὴν καρδίαν.

Ἔχουσι δ' αἱ καρδίαι πᾶσαι μὲν κοιλίας ἐν αὑταῖς, ἀλλ' αἱ μὲν τῶν σφόδρα μικρῶν ζῴων μόλις φανερὰν τὴν μεγίστην ἔχουσι, τὰ δὲ μέσα τῷ μεγέ-
30 θει τῶν ζῴων καὶ τὴν ἑτέραν, τὰ δὲ μέγιστα τὰς τρεῖς. ἔστι δὲ τῆς καρδίας τὸ ὀξὺ ἐχούσης εἰς τὸ πρόσθεν, καθάπερ εἴρηται πρότερον, ἡ μεγίστη μὲν κοιλία ἐν τοῖς δεξιοῖς καὶ ἀνωτάτω αὐτῆς, ἡ δ' ἐλαχίστη ἐν τοῖς ἀριστεροῖς, ἡ δὲ μέση μεγέθει τούτων ἐν τῷ μέσῳ ἀμφοῖν· ἀμφότεραι δὲ πολλῷ ἐλάτ-
35 τους εἰσὶ τῆς μεγίστης. συντέτρηνται μέντοι πᾶσαι αὗται πρὸς τὸν πνεύμονα, ἀλλ' ἄδηλοι ⟨αἱ τρήσεις⟩[1]
513 b διὰ σμικρότητα τῶν πόρων πλὴν μιᾶς.

Ἡ μὲν οὖν μεγάλη φλὲψ ἐκ τῆς μεγίστης ἤρτηται κοιλίας τῆς ἄνω καὶ ἐν τοῖς δεξιοῖς, εἶτα διὰ τοῦ κοίλου τοῦ μέσου τείνασα γίγνεται[2] πάλιν φλέψ, ὡς οὔσης τῆς κοιλίας μορίου τῆς φλεβὸς ἐν ᾧ λιμνάζει
5 τὸ αἷμα. ἡ δ' ἀορτὴ ἀπὸ τῆς μέσης· πλὴν οὐχ οὕτως ἀλλὰ κατὰ στενοτέραν σύριγγα πολλῷ κοινωνεῖ.

Καὶ ἡ μὲν φλὲψ διὰ τῆς καρδίας, †εἰς δὲ τὴν ἀορτὴν[3] ἀπὸ τῆς καρδίας† τείνει. καὶ ἔστιν ἡ μὲν μεγάλη φλὲψ ὑμενώδης καὶ δερματώδης, ἡ δ' ἀορτὴ στενοτέρα μὲν ταύτης, σφόδρα δὲ νευρώδης· καὶ
10 ἀποτεινομένη πόρρω πρός τε τὴν κεφαλὴν καὶ πρὸς τὰ κάτω μόρια στενή τε γίγνεται καὶ νευρώδης πάμπαν.

[1] add. Dt. : *non manifestatur illa perforatio* Σ.
[2] τείνασα γίγνεται Dt. : τείνεται AC, vulg. : γίνεται PD.
[3] add. ⟨πόρος⟩ Dt. : ἡ δ' ἀορτὴ Sylb., Sn., Karsch, alii : ἡ δ' ἀορτὴ εἰς τὴν ἀριστερὰν Th.

blood-vessels are above and below, while the heart lies in the middle between them.

In all animals the heart contains cavities. In those of the very small animals even the largest of the cavities is hardly distinguishable : in those of medium size the second also is distinguishable, whereas in the largest animals all three can be seen. In the heart, then, which as already stated has its pointed end forward, the largest of the cavities is on the right-hand side, and highest up ; the smallest is on the left, and the medium-sized one is between the two. Both of the first-named are much smaller than the largest. All three, however, have connecting-passages with the lung, though these connexions except one are obscure owing to the smallness of all the passages.

Now the Great Blood-vessel is attached to the largest cavity, *i.e.*, the one which is uppermost and on the right side ; then it runs through the middle cavity and reappears as a blood-vessel again, as though the cavity were part of it, like a lake formed by the blood. The Aorta is attached to the middle cavity, though the arrangement is dissimilar : the connexion here is by a much narrower pipe.

Thus the blood-vessel passes through the heart [and it extends into the Aorta from the heart].[a] The Great Blood-vessel is membranous and skinlike in appearance, whereas the Aorta is narrower, and very sinewy ; and as it continues on farther towards the head and the lower parts of the body it becomes very narrow and sinewy indeed.

[a] This statement is incorrect, and inconsistent with Aristotle's account. Some proposals for alteration are noted opposite.

513 b

Τείνει δὲ πρῶτον μὲν ἄνω ἀπὸ τῆς καρδίας τῆς μεγάλης φλεβὸς μόριον πρὸς τὸν πνεύμονα καὶ τὴν σύναψιν τῆς ἀορτῆς, ἄσχιστος καὶ μεγάλη οὖσα φλέψ. σχίζεται δ' ἀπ' αὐτῆς μόρια δύο, τὸ μὲν ἐπὶ τὸν πνεύμονα, τὸ δ' ἐπὶ τὴν ῥάχιν καὶ τὸν ὕστατον τοῦ τραχήλου σφόνδυλον.

Ἡ μὲν οὖν ἐπὶ τὸν πνεύμονα τείνουσα φλὲψ εἰς διμερῆ ὄντ' αὐτὸν διχῇ σχίζεται πρῶτον, εἶτα παρ' ἑκάστην σύριγγα καὶ ἕκαστον τρῆμα τείνει, μείζων μὲν παρὰ τὰ μείζω, ἐλάττων δὲ παρὰ τὰ ἐλάττω, οὕτως ὥστε μηδὲν εἶναι μόριον λαβεῖν ἐν ᾧ οὐ τρῆμά τ' ἔνεστι καὶ φλέβιον· τὰ γὰρ τελευταῖα τῷ μεγέθει ἄδηλα διὰ τὴν μικρότητά ἐστιν, ἀλλὰ πᾶς ὁ πνεύμων φαίνεται μεστὸς ὢν αἵματος. ἐπάνω δ' οἱ ἀπὸ τῆς φλεβός εἰσι πόροι τῶν ἀπὸ τῆς ἀρτηρίας συρίγγων τεινουσῶν. ἡ δ' ἐπὶ τὸν σφόνδυλον τοῦ τραχηλοῦ τείνουσα φλὲψ καὶ τὴν ῥάχιν πάλιν παρὰ τὴν ῥάχιν τείνει· ἣν καὶ Ὅμηρος ἐν τοῖς ἔπεσιν εἴρηκε ποιήσας·

ἀπὸ δὲ φλέβα πᾶσαν ἔκερσεν,
ἥ τ' ἀνὰ νῶτα θέουσα διαμπερὲς αὐχέν' ἱκάνει.

ἀπὸ δὲ ταύτης τείνουσι παρά τε τὴν πλευρὰν ἑκάστην φλέβια καὶ πρὸς ἕκαστον τὸν σφόνδυλον, κατὰ δὲ τὸν ὑπὲρ τῶν νεφρῶν σφόνδυλον σχίζεται διχῇ.

Ταῦτα μὲν οὖν τὰ μόρια ἀπὸ[1] τῆς μεγάλης φλεβὸς τοῦτον ἔσχισται τὸν τρόπον.

Ὑπεράνω δὲ τούτων ἀπὸ τῆς ἐκ τῆς καρδίας τεταμένης πάλιν ἡ ὅλη σχίζεται εἰς δύο τόπους. αἱ μὲν γὰρ φέρουσιν εἰς τὰ πλάγια καὶ τὰς κλεῖδας,

[1] add. ἀπὸ AC, vulg., om. PD.

First, then, there is a part of the Great Blood-vessel which runs up from the heart towards the lung and the attachment of the Aorta : this is a large and undivided blood-vessel. But two parts split off from it : one towards the lung and one towards the backbone and the last vertebra of the neck.

So then the blood-vessel which extends to the lung, because the lung itself is double, splits into two to begin with, and then runs alongside every pipe and every perforation, being larger by the larger ones and smaller by the smaller, in such a way that one can find no part at all where there is not both perforation and blood-vessel ; indeed, the extremities are invisible owing to their excessively small size, and in fact the whole lung looks full of blood. The passages from the blood-vessel are situated above the tubes which extend from the windpipe. And the blood-vessel which runs to the vertebra of the neck and the backbone extends back again alongside the backbone. This is the blood-vessel mentioned by Homer in the passage where he says [a] :

> All that vein he severed through
> Which to the neck runs right along the back.

And from this blood-vessel there run small blood-vessels past each rib and to each vertebra, and at the vertebra above the kidneys the blood-vessel divides into two.

I have now described how these parts branch off from the Great Blood-vessel.

Above these, from that part of the blood-vessel which extends from the heart, the whole blood-vessel divides in two directions. The one set of blood-vessels leads off to the sides and the collar-bones, after that

[a] *Iliad*, xiii. 546 f.

513 b

κἄπειτα διὰ τῶν μασχαλῶν τοῖς μὲν ἀνθρώποις εἰς
514 a τοὺς βραχίονας, τοῖς δὲ τετράποσιν εἰς τὰ πρόσθια σκέλη τείνουσι, τοῖς δ' ὄρνισιν εἰς τὰς πτέρυγας, τοῖς δ' ἰχθύσιν εἰς τὰ πτερύγια τὰ πρανῆ. αἱ δ' ἀρχαὶ τούτων τῶν φλεβῶν, ᾗ σχίζονται τὸ πρῶτον, καλοῦνται σφαγίτιδες· ᾗ δὲ σχίζονται εἰς τὸν αὐχένα
5 [ἀπὸ τῆς μεγάλης φλεβός],[1] παρὰ τὴν ἀρτηρίαν τείνουσιν [τὴν τοῦ πνεύμονος][2]· ὧν ἐπιλαμβανομένων ἐνίοτε ἔξωθεν ἄνευ πνιγμοῦ καταπίπτουσιν αἱ ἄνθρωποι μετ' ἀναισθησίας, τὰ βλέφαρα συμβεβληκότες. οὕτω δὲ τείνουσαι καὶ μεταξὺ λαμβάνουσαι τὴν ἀρτηρίαν φέρουσι μέχρι τῶν ὤτων, ᾗ συμβάλ-
10 λουσιν αἱ γένυες τῇ κεφαλῇ.[3] πάλιν δ' ἐντεῦθεν εἰς τέτταρας σχίζονται φλέβας, ὧν μία μὲν ἐπανακάμψασα καταβαίνει διὰ τοῦ τραχήλου καὶ τοῦ ὤμου, καὶ συμβάλλει τῇ πρότερον ἀποσχίσει τῆς φλεβὸς κατὰ τὴν τοῦ βραχίονος καμπήν, τὸ δ' ἕτερον μόριον εἰς τὴν χεῖρα τελευτᾷ καὶ τοὺς δακτύλους.
15 Μία δ' ἑτέρα ἀφ' ἑκατέρου τοῦ τόπου τοῦ περὶ τὰ ὦτα ἐπὶ τὸν ἐγκέφαλον τείνει, καὶ σχίζεται εἰς πολλὰ καὶ λεπτὰ φλέβια εἰς τὴν καλουμένην μήνιγγα τὴν περὶ τὸν ἐγκέφαλον. αὐτὸς δ' ὁ ἐγκέφαλος ἄναιμος πάντων ἐστί, καὶ οὔτε μικρὸν οὔτε μέγα φλέβιον τελευτᾷ εἰς αὐτόν. τῶν δὲ λοιπῶν
20 τῶν ἀπὸ τῆς φλεβὸς ταύτης σχισθεισῶν φλεβῶν αἱ μὲν τὴν κεφαλὴν κύκλῳ περιλαμβάνουσιν, αἱ δ' εἰς τὰ αἰσθητήρια ἀποτελευτῶσι καὶ τοὺς ὀδόντας λεπτοῖς πάμπαν φλεβίοις.

IV Τὸν δ' αὐτὸν τρόπον καὶ τὰ τῆς ἐλάττονος φλεβός, καλουμένης δ' ἀορτῆς, ἔσχισται μέρη, συμ-
25 παρακολουθοῦντα τοῖς τῆς μεγάλης· πλὴν ἐλάττους

they continue in men through the armpits to the arms, in quadrupeds to the forelegs, in birds to the wings, and in fishes to the pectoral fins. The primary portions of these blood-vessels, where they first divide off, are called the jugular veins ; and where they divide off to the neck they extend alongside the windpipe ; and sometimes if these blood-vessels are pressed from outside, persons though not choked shut their eyes, and fall down unconscious. Running on in this way and keeping the windpipe between them they continue as far as the ears, where the lower jaws connect with the skull. Then again from this point they divide off into four, ⟨two on each side⟩, one of which bends back and runs down through the neck and the shoulder, and connects up with the former branch of the blood-vessel at the bend of the arm, while the other part ends up in the hand and fingers.

Each one of the others runs on its own side from the region round the ear to the brain, and divides up into a number of small delicate blood-vessels into the meninx (as it is called) which surrounds the brain. The brain itself is bloodless in all animals ; no blood-vessel, large or small, terminates there. Of the remaining blood-vessels which divide off from the one just mentioned, some encircle the head, others find their terminus in the sense-organs and the teeth in extremely fine blood-vessels.

In the same way too the parts of the lesser Blood- IV
vessel called the Aorta divide off, following along together with those of the Great Blood-vessel ; the only difference is that the passages and the blood-vessels

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[1] om. Gaza, secl. Dt. [2] secl. Dt.
[3] *τῇ κεφαλῇ* A, Dt. : *τῆς κεφαλῆς* PCD, vulg.

514 a οἱ πόροι καὶ τὰ φλέβια πολλῷ ἐλάττω ταύτης[1] ἐστὶ τῶν τῆς μεγάλης φλεβός.

Τὰ μὲν οὖν ἄνωθεν τῆς καρδίας τοῦτον ἔχουσι τὸν τρόπον αἱ φλέβες.

Τὸ δ' ὑποκάτω τῆς καρδίας μέρος τῆς μεγάλης 30 φλεβὸς τείνει μετέωρον διὰ τοῦ ὑποζώματος, συνέχεται δὲ καὶ πρὸς τὴν ἀορτὴν καὶ πρὸς τὴν ῥάχιν πόροις ὑμενώδεσι καὶ χαλαροῖς. τείνει δ' ἀπ' αὐτῆς μία μὲν διὰ τοῦ ἥπατος φλέψ, βραχεῖα μὲν πλατεῖα δέ, ἀφ' ἧς πολλαὶ καὶ λεπταὶ εἰς τὸ ἧπαρ ἀποτεί- 35 νουσαι ἀφανίζονται. δύο δ' ἀπὸ τῆς διὰ τοῦ ἥπατος φλεβὸς ἀποσχίσεις εἰσίν, ὧν ἡ μὲν εἰς τὸ ὑπόζωμα τελευτᾷ καὶ τὰς καλουμένας φρένας, ἡ δὲ πάλιν ἐπανελθοῦσα διὰ τῆς μασχάλης εἰς τὸν βραχίονα τὸν 514 b δεξιὸν συμβάλλει ταῖς ἑτέραις φλεψὶ κατὰ τὴν ἐντὸς καμπήν· διὸ ἀποσχαζόντων τῶν ἰατρῶν ταύτην ἀπολύονταί τινων πόνων περὶ τὸ ἧπαρ. ἐκ δὲ τῶν ἀριστερῶν αὐτῆς μικρὰ μὲν παχεῖα δὲ φλὲψ τείνει 5 εἰς τὸν σπλῆνα, καὶ ἀφανίζεται τὰ ἀπ' αὐτῆς φλέβια εἰς τοῦτον. ἕτερον δὲ μέρος ἀπὸ τῶν ἀριστερῶν τῆς μεγάλης φλεβὸς ἀποσχισθὲν τὸν αὐτὸν τρόπον ἀναβαίνει ἐπὶ τὸν ἀριστερὸν βραχίονα· πλὴν ἐκείνη μὲν ἡ διὰ τοῦ ἥπατός ἐστιν, αὕτη δ' ἑτέρα τῆς εἰς τὸν σπλῆνα τεινούσης.

10 Ἔτι δ' ἄλλαι ἀπὸ τῆς μεγάλης φλεβὸς ἀποσχίζονται, ἡ μὲν ἐπὶ τὸ ἐπίπλοον, ἡ δ' ἐπὶ τὸ καλούμενον πάγκρεας. ἀπὸ δὲ ταύτης πολλαὶ φλέβες διὰ τοῦ μεσεντερίου τείνουσιν. πᾶσαι δ' αὗται εἰς μίαν φλέβα μεγάλην τελευτῶσιν,[2] παρὰ πᾶν τὸ ἔντερον καὶ τὴν κοιλίαν μέχρι τοῦ στομάχου τεταμένην. καὶ

[1] ταύτης A, Dt. : ταῦτ' PCD. vulg.
[2] μ. τ. AC, Dt. ; τ. μ. vulg.

belonging to the Aorta are much smaller in size than those of the Great Blood-vessel.

With regard to the regions above the heart, such is the disposition of the blood-vessels.

That part of the Great Blood-vessel which lies below the heart runs unattached through the midriff, and is held to the Aorta and the back-bone by slack membranous passages. From it there extends one blood-vessel, which is short and wide, through the liver, and from this numerous fine blood-vessels lead off into the liver and become invisible. From the blood-vessel which passes through the liver two branches divide off: one of them ends up in the diaphragm or midriff as it is called; the other goes back again through the armpit into the right arm and joins up with the other blood-vessels at the inside of the bend; and that is why when doctors lance this blood-vessel people get relief from certain pains in the liver. From the left side of it a small but thick blood-vessel runs to the spleen, and the small blood-vessels which branch off from it enter the spleen and become invisible. Another part divides off from the left side of the Great Blood-vessel and goes up in the same way to the left arm—with this difference, that the former blood-vessel is the one that goes through the liver, whereas this one is distinct from that which goes into the spleen.

There are still further blood-vessels which divide off from the Great Blood-vessel, one to the Omentum, and one to the pancreas as it is called, and from the latter a number of blood-vessels extend through the mesentery. All these terminate into a single large blood-vessel, which extends along the whole length of the gut and the stomach as far as the oesophagus;

514 b

περὶ ταῦτα τὰ μόρια πολλαὶ ἀπ' αὐτῶν σχίζονται φλέβες.

Μέχρι μὲν οὖν τῶν νεφρῶν μία οὖσα ἑκατέρα τείνει, καὶ ἡ ἀορτὴ καὶ ἡ μεγάλη φλέψ· ἐνταῦθα δὲ πρός τε τὴν ῥάχιν μᾶλλον προσπεφύκασι καὶ σχίζονται εἰς δύο ὥσπερεὶ λάμβδα[1] ἑκατέρα, καὶ γίγνεται εἰς τοὔπισθεν μᾶλλον ἡ μεγάλη φλὲψ τῆς ἀορτῆς. προσπέφυκε δ' ἡ ἀορτὴ μάλιστα τῇ ῥάχει περὶ τὴν καρδίαν· ἡ δὲ πρόσφυσίς ἐστι φλεβίοις νευρώδεσι καὶ μικροῖς. ἔστι δ' ἡ ἀορτὴ ἀπὸ μὲν τῆς καρδίας ἀγομένη εὖ μάλα κοίλη, προϊοῦσα δ' ἐστὶ στενοτέρα[2] καὶ νευρωδεστέρα. τείνουσι δὲ καὶ ἀπὸ τῆς ἀορτῆς εἰς τὸ μεσεντέριον φλέβες ὥσπερ αἱ ἀπὸ τῆς μεγάλης φλεβός, πλὴν πολλῷ λειπόμεναι τῷ μεγέθει· στεναὶ γάρ εἰσι καὶ ἰνώδεις, λεπτοῖς δὲ[3] καὶ ποικίλοις[4] καὶ ἰνώδεσι τελευτῶσι φλεβίοις. εἰς δὲ τὸ ἧπαρ καὶ τὸν σπλῆνα οὐδεμία τείνει ἀπὸ τῆς ἀορτῆς φλέψ.

Αἱ δὲ σχίσεις ἑκατέρας τῆς φλεβὸς τείνουσιν εἰς τὸ ἰσχίον ἑκάτερον, καὶ καθάπτουσιν εἰς τὸ ὀστοῦν ἀμφότεραι. φέρουσι δὲ καὶ εἰς τοὺς νεφροὺς ἀπό τε τῆς μεγάλης φλεβὸς καὶ τῆς ἀορτῆς φλέβες· πλὴν οὐκ εἰς τὸ κοῖλον ἀλλ' εἰς τὸ σῶμα καταναλίσκονται τῶν νεφρῶν. ἀπὸ μὲν οὖν τῆς ἀορτῆς ἄλλοι δύο πόροι φέρουσιν εἰς τὴν κύστιν, ἰσχυροὶ καὶ συνεχεῖς· καὶ ἄλλοι ἐκ τοῦ κοίλου τῶν νεφρῶν, οὐδὲν κοινωνοῦντες τῇ μεγάλῃ φλεβί. ἐκ μέσου δὲ τῶν νεφρῶν ἑκατέρου φλὲψ κοίλη καὶ νευρώδης ἐξήρτηται, τεί-

[1] λάμβδα ACD : λάβδα P, vulg.
[2] ἐστὶ στενωτέρα Camot. : ἔτι στενο(ω)τέρα AC : ἐπιστενότερα P, ἐπιστενωτέρα vulg.
[3] δὲ Dt. : γὰρ vulg.
[4] ποικίλοις AC, Dt. : κοίλοις PD, vulg. : κυκλικοῖς coni. Th. : *subtilis vacua* Σ.

and round these parts many blood-vessels branch off from them.

The Aorta and the Great Blood-vessel, each still single and undivided, extend as far as the kidneys : here they become more closely attached to the back-bone, and each divides into two, like the shape of the letter lambda, and the Great Blood-vessel gets round somewhat to the back of the Aorta. The Aorta is most firmly attached to the backbone near the heart, and this attachment is by means of very small sinewy blood-vessels. The Aorta, when it strikes off from the heart, is a hollow tube of considerable size, but as it proceeds it is narrower and more sinewy. Also, from the Aorta there are blood-vessels extending to the mesentery, just like those which come from the Great Blood-vessel, except that they are much smaller in size : they are narrow and fibrous, and they end up in very fine and complicated fibrous blood-vessels. No blood-vessel runs from the Aorta to the liver or to the spleen.

Branches from each of the two great blood-vessels extend to each flank, and they both attach themselves to the bone. [a] There are also blood-vessels leading to the kidneys both from the Great Blood-vessel and from the Aorta, except that they do not go into the cavity of the kidney but peter out in the mass of the kidneys themselves. Now there are, leading from the Aorta, two other passages into the bladder, which are strong and continuous ; and there are others from the cavity of the kidneys, which have no communication with the Great Blood-vessel. From the middle of each kidney a hollow sinewy blood-vessel

[a] The following passage, down to 515 a 2, closely follows the passage in the first Book, 497 a 4 ff.

514 b

νουσα παρ' αὐτὴν τὴν ῥάχιν διὰ τῶν στενῶν[1]· εἶτα
515 a εἰς ἑκάτερον τὸ ἰσχίον ἀφανίζεται ἑκατέρα πρῶτον, ἔπειτα δῆλαι γίγνονται πάλιν διατεταμέναι πρὸς τὸ ἰσχίον.[2] καθάπτουσι δὲ πρὸς [τὴν κύστιν καὶ][3] τὸ αἰδοῖον τὰ πέρατα αὐτῶν ἐν τοῖς ἄρρεσιν, ἐν δὲ τοῖς θήλεσι πρὸς τὰς ὑστέρας. τείνει δ' ἀπὸ μὲν τῆς μεγάλης φλεβὸς οὐδεμία εἰς τὰς ὑστέρας, ἀπὸ δὲ τῆς ἀορτῆς πολλαὶ καὶ πυκναί.

Τείνουσι δ' ἀπό τε[4] τῆς ἀορτῆς καὶ τῆς μεγάλης φλεβὸς σχιζομένων[5] καὶ ἄλλαι, αἱ μὲν ἐπὶ τοὺς βουβῶνας πρῶτον μεγάλαι καὶ κοῖλαι, ἔπειτα διὰ τῶν σκελῶν τελευτῶσιν εἰς τοὺς πόδας καὶ τοὺς δακτύλους· καὶ πάλιν ἕτεραι διὰ τῶν βουβώνων καὶ τῶν μηρῶν φέρουσιν ἐναλλάξ, ἡ μὲν ἐκ τῶν ἀριστερῶν εἰς τὰ δεξιά, ἡ δ' εἰς τὰ ἀριστερὰ ἐκ τῶν δεξιῶν· καὶ συνάπτουσι περὶ τὰς ἰγνύας ταῖς ἑτέραις φλεψίν.

Ὃν μὲν οὖν τρόπον ἔχουσιν αἱ φλέβες καὶ πόθεν ἤρτηνται τὰς ἀρχάς, φανερὸν ἐκ τούτων.

Ἔχει δ' ἐν ἅπασι μὲν τοῖς ἐναίμοις ζῴοις οὕτω[6] τὰ περὶ τὰς ἀρχὰς καὶ τὰς μεγίστας φλέβας (τὸ γὰρ ἄλλο πλῆθος τῶν φλεβῶν οὐχ ὡσαύτως ἔχει πᾶσιν· οὐδὲ γὰρ τὰ μέρη τὸν αὐτὸν τρόπον ἔχουσιν, οὐδὲ ταὐτὰ πάντα[7] ἔχουσιν), οὐ μὴν οὐδ' ὁμοίως ἐν ἅπασίν ἐστι φανερόν, ἀλλὰ μάλιστα ἐν τοῖς μάλιστα πολυαίμοις καὶ μεγίστοις. ἐν γὰρ τοῖς μικροῖς καὶ μὴ πολυαίμοις ἢ διὰ φύσιν ἢ διὰ πιότητα τοῦ σώ-

[1] στενῶν Dt. ex 497 a 15 : φλεβῶν vulg. : νευρῶν A : νεφρῶν Buss. : *et deinde ad hancas* (=ἰσχίον) Σ.

[2] v. 34 καὶ ἄλλοι . . . ἰσχίον secl. A.-W., Dt. ut ex 497 a 11 sqq. decerpta.

[3] τὴν κ. καὶ secl. Dt. : habet Σ.

[4] τε PD, om. AC, vulg.

[5] ἀπὸ τῶν ante σχ. vulg., delent A.-W.

is attached, which runs alongside the backbone itself through the narrow regions ; afterwards each of these blood-vessels disappears into its own flank, and farther on reappears extended towards the flank. The ends of these attach themselves [to the bladder and] to the penis in males, and in females to the uterus. From the Great Blood-vessel there is no blood-vessel running to the uterus, but there are many clustered together which do so from the Aorta.

Also, from the Aorta and the Great Blood-vessel where they branch off there are other blood-vessels, some of which—large hollow ones—run first to the groins, and then through the legs and finish up in the feet and toes ; while others run through the groins and the thighs criss-cross, across from left to right and from right to left, and they join up with the other blood-vessels in the hams.

It will be clear from the foregoing account how the blood-vessels are disposed and where they have their starting-points and attachments.

The description just given of the starting-points and the chief blood-vessels applies to all blooded animals, though the remainder of the blood-vessels (which are numerous) are not arranged in that way in all of them. Indeed, the parts of the body are not arranged in the same way in all, nor do all animals possess exactly the same parts. And furthermore, the state of affairs is not equally discernible in all animals : it is clearest in those animals which are largest and contain the greatest abundance of blood ; for in the small ones which lack an abundance of blood, either because that is their natural condition

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[6] *οὕτω(ς)* hic A ; cett., vulg. post *μὲν*.

[7] *τὰ αὐτὰ π.* C : *π. τὰ αὐτὰ* PD : *ταῦτα π.* A, vulg.

515 a

ματος οὐχ ὁμοίως ἔστι καταμαθεῖν· τῶν μὲν γὰρ οἱ πόροι συγκεχυμένοι καθάπερ ὀχετοί τινες ὑπὸ πολλῆς ἰλύος εἰσίν, οἱ δ' ὀλίγας καὶ ταύτας ἴνας ἀντὶ φλεβῶν ἔχουσιν. ἡ δὲ μεγάλη φλὲψ ἐν πᾶσι μάλιστα διάδηλος, καὶ τοῖς μικροῖς.

V Τὰ δὲ νεῦρα τοῖς ζῴοις ἔχει τόνδε τὸν τρόπον. ἡ μὲν ἀρχὴ καὶ τούτων ἐστὶν ἀπὸ[1] τῆς καρδίας· καὶ γὰρ ἐν αὐτῇ ἡ καρδία ἔχει νεῦρα ἐν τῇ μεγίστῃ κοιλίᾳ, καὶ ἡ καλουμένη ἀορτὴ νευρώδης ἐστὶ φλέψ, τὰ μέντοι[2] τελευταῖα καὶ παντελῶς αὐτῆς· ἄκοιλα γάρ ἐστι, καὶ τάσιν ἔχει τοιαύτην οἵαν περ τὰ νεῦρα, ᾗ τελευτᾷ πρὸς τὰς καμπὰς τῶν ὀστῶν. οὐ μὴν ἀλλ' οὐκ ἔστι συνεχὴς ἡ τῶν νεύρων φύσις ἀπὸ μιᾶς ἀρχῆς, ὥσπερ αἱ φλέβες. αἱ μὲν γὰρ φλέβες, ὥσπερ ἐν τοῖς γραφομένοις κανάβοις, τὸ τοῦ σώματος ἔ-
515 b χουσι σχῆμα παντὸς οὕτως ὥστ' ἐν τοῖς σφόδρα λελεπτυσμένοις πάντα τὸν ὄγκον φαίνεσθαι πλήρη φλεβίων (γίγνεται γὰρ ὁ αὐτὸς τόπος λεπτῶν μὲν ὄντων φλέβια, παχυνθέντων δὲ σάρκες), τὰ δὲ νεῦρα διεσπασμένα περὶ τὰ ἄρθρα καὶ τὰς τῶν ὀστῶν ἐστι κάμψεις. εἰ δ' ἦν συνεχὴς ἡ φύσις αὐτῶν, ἐν τοῖς λελεπτυσμένοις ἂν καταφανὴς ἐγίγνετο ἡ συνέχεια πάντων.

Μέγιστα δὲ μέρη τῶν νεύρων τό τε περὶ τὸ

[1] ἀπὸ AC : ἐκ PD, vulg.
[2] μέντοι Sn. : μὲν vulg.

[a] A similar comparison is found at *P.A.* 668 a 14 ff., a 27 ff.
[b] *Cf.* *G.A.* 743 a 2, where the same illustration is used. Hesychius's and Photius's definitions of κάναβοι describe them as the woodwork round which modellers, when they begin their modelling, mould the wax or plaster. There is a similar

or because their bodies are so fat, it is less easy to ascertain what the arrangement is. Thus, in some of them the passages get choked up, as it might be so many irrigation-channels silted up with mud,[a] and in others there are just a few perforated fibres instead of blood-vessels. Nevertheless, the Great Blood-vessel is clearly visible in all, even in the smallest.

V Sinews.

The sinews of animals are arranged as follows. The starting-point of them, as of the blood-vessels, is the heart: the heart has sinews within itself, in the largest cavity; and the Aorta as it is called is a sinewy blood-vessel; indeed, its extremities are wholly sinewy; they are not hollow, and it can be stretched in the same way as the sinews where they terminate at the joints of the bones. Nevertheless, the sinews do not constitute a continuous system from one starting-point, as the blood-vessels do. No; the difference is this. The blood-vessels are like the lines of the wooden skeletons used in modelling [b]— they display the shape of the entire body, so that in very attenuated persons the whole bulk of the body appears to be full of small blood-vessels: the whole space which in well-fattened persons is occupied by flesh, in thin ones is occupied by small blood-vessels. The sinews, on the other hand, are scattered about round the joints and the flexions of the bones. If they were a continuous system, their continuity would be evident in attenuated persons.

A very important part of the sinews is that in the

passage in *P.A.* (654 b 29), though without mention of the term κάναβος; there Aristotle speaks of a "hard and solid core or foundation" round which the figure is modelled, though in that passage he is speaking of the bones. Clearly something more substantial than a mere outline or sketch seems to be intended. *Cf.* also *G.A.* 764 b 31.

515 b

μόριον τὸ τῆς ἄλσεως κύριον (καλεῖται δὲ τοῦτο ἰγνύα), καὶ ἕτερον νεῦρον διπτυχές, ὁ τένων, καὶ τὰ πρὸς τὴν ἰσχὺν βοηθητικά, ἐπίτονός τε καὶ ὠμιαία.[a] τὰ δ' ἀνώνυμα περὶ τὴν τῶν ὀστῶν ἐστὶ κάμψιν· πάντα γὰρ τὰ ὀστᾶ, ὅσα ἁπτόμενα πρὸς ἄλληλα σύγκεινται, συνδέδενται νεύροις, καὶ περὶ πάντα ἐστὶ τὰ ὀστᾶ πλῆθος νεύρων. πλὴν ἐν τῇ κεφαλῇ οὐκ ἔστιν οὐδέν, ἀλλ' αἱ ῥαφαὶ αὐτῶν τῶν ὀστῶν συνέχουσιν αὐτήν.

Ἔστι δ' ἡ τοῦ νεύρου φύσις σχιστὴ κατὰ μῆκος, κατὰ δὲ πλάτος ἄσχιστος καὶ τάσιν ἔχουσα πολλήν. ὑγρότης δὲ περὶ αὐτὰ[1] μυξώδης γίγνεται, λευκὴ καὶ κολλώδης, ᾗ τρέφεται καὶ ἐξ ἧς γιγνόμενα φαίνεται. ἡ μὲν οὖν φλὲψ δύναται πυροῦσθαι, νεῦρον δὲ πᾶν φθείρεται πυρωθέν· κἂν διακοπῇ, οὐ συμφύεται πάλιν. οὐ λαμβάνει δ' οὐδὲ νάρκη, ὅπου μὴ νεῦρόν ἐστι τοῦ σώματος.

Πλεῖστα δ' ἐστὶ νεῦρα περὶ τοὺς πόδας καὶ τὰς χεῖρας καὶ πλευρὰς καὶ ὠμοπλάτας καὶ περὶ τὸν αὐχένα καὶ τοὺς βραχίονας.

Ἔχει δὲ νεῦρα πάντα ὅσα ἔχει αἷμα· ἀλλ' ἐν οἷς μή εἰσι καμπαὶ ἀλλ' ἄποδα καὶ ἄχειρά ἐστι, λεπτὰ καὶ ἄδηλα· διὸ τῶν ἰχθύων μάλιστά ἐστι δῆλα πρὸς τοῖς πτερυγίοις.

VI Αἱ δ' ἶνές εἰσι μεταξὺ νεύρου καὶ φλεβός. ἔνιαι δ' αὐτῶν ἔχουσιν ὑγρότητα τὴν τοῦ ἰχῶρος, καὶ δι-

[1] αὐτὰ AC : ταῦτα PD, vulg.

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[a] At Plato, *Timaeus* 84 E, ἐπίτονος is used of the great sinews of the shoulder and arm. The term is also used of the backstay of a mast (Homer, *Od.* xii. 423).

[b] The phrase used here, " bound together by sinews," is

region which controls the act of jumping (the part known as the ham) ; another sinew, a double one, is the *tenon* (tendon), and those which are called upon for feats of strength, *viz.*, the *epitonos* [a] and the shoulder-sinews. The sinews which have no special name are at the flexions of the bones : all the bones which are attached to one another are bound together by sinews,[b] and there is a large number of sinews round all the bones. An exception is the head, which contains none, being held together by the sutures of the bones themselves.

The texture of sinew is such that it can be split lengthwise, but not crosswise ; and it admits of a high degree of tension. Round the sinews a mucous liquid is formed, which is white and glutinous ; the sinews are nourished by this, and we can see them being formed out of it. Now blood-vessel can be cauterized, but sinew when cauterized is completely destroyed ; and if sinew is cut it does not grow together again. And numbness never takes effect in any part of the body where no sinew is present.

The greatest number of sinews is found in connexion with the feet, the hands, the ribs, the shoulder-blades, the neck, and the arms.

All blooded animals have sinews ; but in those animals which have no flexions in their limbs, *i.e.*, which are without hands and feet, the sinews are thin and difficult to see ; and that is why in fishes they are most clearly to be seen near the fins.

VI Fibres.

Fibres [c] are intermediate between sinew and blood-vessel. Some fibres have fluid, *viz.*, *ichor*, and they

probably the source of interpolations into the description of the bones in *P.A.* 654 b 15-25 (see Loeb ed.). Sinews are not separately treated of in *P.A.*

[c] See note on 489 a 23.

515 b

ἔχουσιν ἀπό τε τῶν νεύρων πρὸς τὰς φλέβας καὶ ἀπ' ἐκείνων πρὸς τὰ νεῦρα. ἔστι δὲ καὶ ἄλλο γένος ἰνῶν, ὃ γίγνεται μὲν ἐν αἵματι, οὐκ ἐν ἅπαντος δὲ ζῴου αἵματι· ὧν ἐξαιρουμένων ἐκ τοῦ αἵματος οὐ πήγνυται τὸ αἷμα, ἐὰν δὲ μὴ ἐξαιρεθῶσι, πήγνυται. ἐν μὲν οὖν τῷ τῶν πλείστων αἵματι ζῴων ἔνεισιν, ἐν δὲ τῷ τῆς ἐλάφου καὶ προκὸς καὶ βουβαλίδος καὶ ἄλλων τινῶν οὐκ ἔνεισιν ἶνες· διὸ καὶ οὐ πήγνυται αὐτῶν τὸ αἷμα ὁμοίως τοῖς ἄλλοις, ἀλλὰ τὸ μὲν τῶν ἐλάφων παραπλησίως τῷ τῶν δασυπόδων (ἔστι δ' ἀμφοτέρων αὐτῶν ἡ πῆξις οὐ στιφρά, καθάπερ ἡ τῶν ἄλλων, ἀλλὰ πλαδῶσα, καθάπερ ἡ τοῦ γάλακτος, ἄν τις εἰς αὐτὸ τὸ πῆγμα μὴ ἐμβάλῃ), τὸ δὲ τῆς βουβαλίδος πήγνυται μᾶλλον· παραπλησίως γὰρ συνίσταται ἢ μικρῷ ἧττον τοῦ τῶν προβάτων.

516 a

Περὶ μὲν οὖν φλεβὸς καὶ νεύρου καὶ ἰνὸς τοῦτον ἔχει τὸν τρόπον.

VII Τὰ δ' ὀστᾶ τοῖς ζῴοις ἀφ' ἑνὸς πάντα συνηρτημένα ἐστὶ καὶ συνεχῆ ἀλλήλοις ὥσπερ αἱ φλέβες· αὐτὸ δὲ καθ' αὑτὸ οὐδέν ἐστιν ὀστοῦν. ἀρχὴ δ' ἡ ῥάχις ἐστὶν ἐν πᾶσι τοῖς ἔχουσιν ὀστᾶ. σύγκειται δ' ἡ ῥάχις ἐκ σφονδύλων, τείνει δ' ἀπὸ τῆς κεφαλῆς μέχρι πρὸς τὰ ἰσχία. οἱ μὲν οὖν σφόνδυλοι πάντες τετρημένοι εἰσίν, ἄνω δὲ τὸ τῆς κεφαλῆς ὀστοῦν συνεχές ἐστι τοῖς ἐσχάτοις σφονδύλοις, ὃ καλεῖται κρανίον. τούτου δὲ τὸ πριονωτὸν μέρος ῥαφή. ἔστι δ' οὐ πᾶσιν ὁμοίως ἔχον τοῦτο τοῖς ζῴοις· τὰ μὲν

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[a] βουβαλίς, an African antelope. Also mentioned (as βούβαλος) at *P.A.* 663 a 11.

[b] *Cf.* Goethe's famous "vertebral theory," according to which the structure of the skull can be explained as a fused

extend from the sinews to the blood-vessels and *vice versa*. There is also another kind of fibres, which occurs in blood, but not in the blood of every animal. If the fibres are taken out of the blood it does not congeal, whereas if they are not taken out it does. Now fibres are present in the blood of most animals, but there are none in the blood of the deer, the roe, the antelope,[a] and some others, and that is why their blood does not coagulate as much as other animals' does. That of the deer coagulates about as much as the hare's : in both these animals the coagulation is not stiff, as in other cases, but flaccid, like the coagulation of milk if one does not put the rennet well into it. The blood of the antelope coagulates better : it coagulates similarly to that of sheep, or perhaps a little less.

Such then is the nature of blood-vessel, sinew, and fibre.

VII Bones.

The bones in animals are all connected with one single bone and are a continuous system, like the blood-vessels : there is no such thing as a bone all on its own. In all animals which possess bones the backbone is their starting-point and origin. It consists of vertebrae, and extends from the head down to the loins. The vertebrae are all perforated ; and at the top the bone of the head is continuous with the endmost vertebrae [b] : it is called the skull. The serrated part of this is a suture. The skull is not identical in

series of bone-groups, comparable to the series of vertebrae. See E. S. Russell, *Form and Function*, London, 1916, pp. 49, 96 ff., where he gives the reference in Goethe, *Zur Morphologie*, i. 2, p. 250 (1820), and ii. 2, pp. 122-124 (1824). Goethe made his discovery in 1790 while contemplating a dried sheep's skull in the Jewish cemetery at Venice, but he did not publish it until 30 years later.

516 a

γὰρ ἔχει μονόστεον τὸ κρανίον, ὥσπερ κύων, τὰ δὲ συγκείμενον, ὥσπερ ἄνθρωπος, καὶ τούτου τὸ μὲν θῆλυ κύκλῳ ἔχει τὴν ῥαφήν, τὸ δ' ἄρρεν τρεῖς ῥαφὰς ἄνωθεν συναπτούσας, τριγωνοειδεῖς· ἤδη δ' ὤφθη καὶ ἀνδρὸς κεφαλὴ οὐκ ἔχουσα ῥαφάς. σύγκειται δ' ἡ κεφαλὴ οὐκ ἐκ τεττάρων ὀστῶν, ἀλλ' ἐξ ἕξ· ἔστι δὲ δύο τούτων περὶ τὰ ὦτα, μικρὰ πρὸς τὰ λοιπά. ἀπὸ δὲ τῆς κεφαλῆς αἱ σιαγόνες τείνουσιν ὀστᾶ. [κινεῖται δὲ τοῖς μὲν ἄλλοις ζῴοις ἅπασιν ἡ κάτωθεν σιαγών· ὁ δὲ κροκόδειλος ὁ ποτάμιος μόνος τῶν ζῴων κινεῖ τὴν σιαγόνα τὴν ἄνωθεν.][1] ἐν δὲ ταῖς σιαγόσιν ἔνεστι τὸ τῶν ὀδόντων γένος, ὀστοῦν τῇ μὲν ἄτρητον τῇ δὲ τρητόν, καὶ ἀδύνατον γλύφεσθαι τῶν ὀστῶν μόνον.

Ἀπὸ δὲ τῆς ῥάχεως ἥ τε περωνίς[2] ἐστι καὶ αἱ κλεῖδες καὶ αἱ πλευραί. ἔστι δὲ καὶ τὸ στῆθος ἐπὶ πλευραῖς κείμενον· ἀλλ' αὗται μὲν συνάπτουσιν, αἱ δ' ἄλλαι ἀσύναπτοι· οὐδὲν γὰρ ἔχει ζῷον ὀστοῦν περὶ τὴν κοιλίαν. ἔτι δὲ τά τ' ἐν τοῖς ὤμοις ὀστᾶ, καὶ αἱ καλούμεναι ὠμοπλάται, καὶ τὰ τῶν βραχιόνων ἐχόμενα, καὶ[3] τούτων, τὰ ἐν ταῖς χερσίν. ὅσα δ' ἔχει σκέλη πρόσθια, καὶ ἐν τούτοις τὸν αὐτὸν ἔχει τρόπον.

Κάτω δ' ᾗ περαίνει, μετὰ τὸ ἰσχίον ἡ κοτυληδών ἐστι καὶ τὰ τῶν σκελῶν ἤδη ὀστᾶ, τά τ' ἐν τοῖς

[1] secl. A.-W., Dt., ut ex 492 b 23 decerpta.

[2] περόνη D, vulg.; mox κλεῖς PD, vulg.; ἥ τε . . . κλεῖδες suspic. A.-W.; ἄνω δὲ τῆς ῥ. ᾗ περαίνει coni. Th.

[3] καὶ <τὰ> Dt.

all animals : in some it consists of a single bone (*e.g.*, the dog), in others it is composite (*e.g.*, man), and here the female has a circular suture, whereas in the male there are three sutures which unite at the top, and are shaped like a triangle.[a] A man's head has actually been observed with no sutures at all.[b] The head is composed not of four bones but of six : two of these are by the ears, and are small compared with the rest. From the head extend the jaws, which are bones. [All animals except one move the lower jaw —all except the river crocodile, which moves the upper one.] [c] In the jaws are the teeth, which consist of bone, and are partly perforated, partly not : this is the only bone which resists the graving-tool.

From the backbone extend the *perōnis*,[d] the collar-bones, and the ribs. The chest lies upon ribs ; but these ribs meet together, whereas the others do not, since no animal has any bone round the stomach. Further, there are the bones of the shoulder—what are called the shoulder-blades, and the bones of the arms, which are connected with them, and in their turn, connected with these, the bones in the hands. The bones in the forelegs (in those animals which have forelegs) are of similar formation.

At the lower terminus of the backbone, after the haunch-bone, is the hip-socket, and then immediately the leg-bones, *i.e.*, the thigh- and shank-bones, which

[a] *Cf.* 491 b 2. For a suggested explanation of Aristotle's belief that male and female skulls differ see W. Ogle's note on *P.A.* 653 b 1 (page 168).

[b] As stated in Herodotus ix. 83.

[c] This sentence is considered by A.-W. to be an interpolation.

[d] περωνίς appears to be another form of περόνη, the basic meaning of which is pin, bolt, or rivet. Various suggestions have been made for altering the text.

516 b μηροῖς καὶ κνήμαις, οἷ καλοῦνται κωλῆνες, ὧν μέρος τὰ σφυρὰ καὶ τούτων τὰ καλούμενα πλῆκτρα ἐν τοῖς ἔχουσι σφυρόν[1]· καὶ τούτοις συνεχῆ τὰ ἐν τοῖς ποσίν.

Ὅσα μὲν οὖν τῶν ἐναίμων καὶ πεζῶν ζῳοτόκα ἐστίν, οὐ πολὺ διαφέρει τὰ ὀστᾶ, ἀλλὰ κατ' ἀνα- 5 λογίαν μόνον σκληρότητι καὶ μαλακότητι καὶ μεγέθει. ἔτι δὲ τὰ μὲν ἔχει μυελὸν τὰ δ' οὐκ ἔχει τῶν ἐν τῷ αὐτῷ ζῴῳ ὀστῶν. ἔνια δὲ ζῷα οὐδ' ἂν ἔχειν δόξειεν ὅλως μυελὸν ἐν τοῖς ὀστοῖς, οἷον λέων, διὰ τὸ πάμπαν ἔχειν μικρὸν καὶ λεπτὸν καὶ ἐν ὀλίγοις· ἔχει γὰρ ἐν τοῖς μηροῖς καὶ βραχίοσιν. στερεὰ δὲ 10 πάντων μάλιστα ὁ λέων ἔχει τὰ ὀστᾶ· οὕτω γάρ ἐστι σκληρὰ ὥστε συντριβομένων ὥσπερ ἐκ λίθων ἐκλάμπειν πῦρ. ἔχει δὲ[2] καὶ ὁ δελφὶς ὀστᾶ, ἀλλ' οὐκ ἄκανθαν.

Τὰ δὲ τῶν ἄλλων ζῴων τῶν ἐναίμων τὰ μὲν μικρὸν παραλλάττει, οἷον τὰ τῶν ὀρνίθων, τὰ δὲ τῷ ἀνάλογόν ἐστι ταὐτά, οἷον ἐν τοῖς ἰχθύσι. τούτων 15 γὰρ τὰ μὲν ζῳοτοκοῦντα χονδράκανθά ἐστιν, οἷον τὰ καλούμενα σελάχη, τὰ δ' ᾠοτοκοῦντα ἄκανθαν ἔχει, ἥ ἐστιν ὥσπερ ἐν τοῖς τετράποσιν ἡ ῥάχις. ἴδιον δ' ἐν τοῖς ἰχθύσιν, ὅτι ἐν ἐνίοις εἰσὶ κατὰ τὴν σάρκα κεχωρισμένα ἀκάνθια λεπτά. ὁμοίως δὲ καὶ 20 ὁ ὄφις ἔχει τοῖς ἰχθύσιν· ἀκανθώδης γὰρ ἡ ῥάχις αὐτοῦ ἐστιν. τὰ δὲ τῶν τετραπόδων μὲν ᾠοτο-

[1] καὶ τούτων . . . σφυρόν secl. A.-W., Dt.: τοῖς ἔχουσι <καὶ ἔχουσι> σφ. Gohlke. [2] δὲ A : om. PD, vulg.

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[a] The term πλῆκτρον is otherwise regularly used of a bird's

are called *cōlēnes* (*i.e.*, limb-bones), of which the ankle is a part, and another part of them is the so-called *plectra* [a] which are found in those animals which have an ankle. Continuous with these are the bones in the feet.

In those blooded and footed animals which are viviparous, the bones do not differ much : they differ only " by analogy," [b] *i.e.*, in hardness and softness, and in size. A further difference is that, in the same animal, some bones will contain marrow and others will not. Some animals would appear to have no marrow at all in their bones, *e.g.*, the lion, on account of having very little marrow indeed, and that thin, and in a few bones only ; actually, there is marrow in the thigh and arm-bones. The bones of the lion are more solid than in any other animal ; they are so hard that when they are rubbed together sparks fly out as though from flint. The dolphin is included among those that have bone, not fish-spine.

Of other blooded animals, the bones of some show but little deviation from what has been described, *e.g.*, birds ; others are the same " by analogy," *e.g.*, the bones of fishes : thus, the viviparous fishes are cartilaginous-spined, *e.g.*, the Selachia as they are called, while the oviparous ones have a spine corresponding to the backbone in quadrupeds. A peculiar feature in fishes is that in some species there are small thin spines unconnected together throughout the flesh. The serpent is similar to fishes, having a spinous backbone. With the oviparous quadrupeds,

spur, *e.g.*, 504 b 7, and at 526 a 5 certain projections on the feet of crayfish are compared to spurs. The word means, literally, something used for striking ; hence its application to the instrument used for striking a lyre.

[b] See Notes, § 3.

516 b κούντων δὲ τῶν μὲν μειζόνων ὀστωδέστερά ἐστι, τῶν δ' ἐλαττόνων ἀκανθωδέστερα. πάντα δὲ τὰ ζῷα ὅσα ἔναιμά ἐστιν, ἔχει ῥάχιν ἢ ὀστώδη ἢ ἀκανθώδη· τὰ δ' ἄλλα μόρια τῶν ὀστῶν ἐν ἐνίοις μέν ἐστιν, ἐν[1] ἐνίοις δ' οὐκ ἔστιν, ἀλλ' ὡς ὑπάρχει τοῦ ἔχειν τὰ μόρια, οὕτω καὶ τοῦ ἔχειν τὰ ἐν τούτοις ὀστᾶ. ὅσα γὰρ μὴ ἔχει σκέλη καὶ βραχίονας, οὐδὲ κωλῆνας ἔχει, οὐδ' ὅσα ταὐτὰ μὲν ἔχει μόρια, μὴ ὅμοια δέ· καὶ γὰρ ἐν τούτοις ἢ τῷ μᾶλλον καὶ ἧττον διαφέρει ἢ τῷ ἀνάλογον.

Τὰ μὲν οὖν περὶ τὴν τῶν ὀστῶν φύσιν τοῦτον ἔχει τὸν τρόπον τοῖς ζῴοις.

VIII Ἔστι δὲ καὶ ὁ χόνδρος τῆς αὐτῆς φύσεως τοῖς ὀστοῖς, ἀλλὰ τῷ μᾶλλον διαφέρει καὶ ἧττον. καὶ ὥσπερ οὐδ' ὀστοῦν οὐδ' ὁ χόνδρος αὐξάνεται, ἂν ἀποκοπῇ. εἰσὶ δ' ἐν μὲν τοῖς χερσαίοις καὶ ζῳοτόκοις τῶν ἐναίμων ἄτρητοι οἱ χόνδροι, καὶ οὐ γίγνεται ἐν αὐτοῖς ὥσπερ ἐν τοῖς ὀστοῖς μυελός· ἐν δὲ τοῖς σελάχεσιν (ταῦτα γάρ ἐστι χονδράκανθα) ἔν-
517 a εστιν [αὐτῶν ἐν τοῖς πλατέσι][2] τὸ κατὰ τὴν ῥάχιν ἀνάλογον τοῖς ὀστοῖς χονδρῶδες, ἐν ᾧ[3] ὑπάρχει ὑγρότης μυελώδης. τῶν δὲ ζῳοτοκούντων καὶ [τῶν] πεζῶν[4] περί τε τὰ ὦτα χόνδροι εἰσὶ καὶ τοὺς μυκτῆρας καὶ περὶ ἔνια ἀκρωτήρια τῶν ὀστῶν.

IX Ἔτι δ' ἐστὶν ἄλλα γένη μορίων, οὔτε τὴν αὐτὴν ἔχοντα φύσιν τούτοις οὔτε πόρρω τούτων, οἷον ὄνυχές τε καὶ ὁπλαὶ καὶ χηλαὶ καὶ κέρατα—καὶ ἔτι παρὰ ταῦτα ῥύγχος, οἷον ἔχουσιν οἱ ὄρνιθες—ἐν οἷς

[1] ἐν (bis) AC : om. PD, vulg.
[2] aut suspicantur aut eiciunt edd. : om. Σ.
[3] ᾧ A.-W. : οἷς codd., vulg.
[4] sic AC (ζωοτόκων A) : τῶν delent A.-W. : τῶν ζ. δὲ π. PD, vulg.

the larger of them have more bone-like skeletons, the smaller more spine-like ones. But all blooded animals have a backbone, whether bony or spinous. The other parts of the bone-system are present in some animals, absent in others ; but whatever parts they have or do not have, there is a corresponding presence or absence of the bones proper to those parts. Animals which have no legs or arms have no limb-bones (*cōlēnes*) either ; and the same is true of those which, though they have the same parts, have them in a modified form : in these animals the bones differ either by " the more and less " or else " by analogy." [a]

I have now described the nature of the bones in animals.

VIII Cartilage.

Cartilage is of the same nature as the bones, but differs from them by way of " the more and less," [b] and, like bone,[c] cartilage does not grow again if it is cut. In those blooded animals which are terrestrial and viviparous, the cartilaginous parts are not perforated, and there is no marrow in them as there is in bones ; but in the Selachia (because they are cartilaginous-spined) the cartilage which constitutes their backbone is for them analogous to bones, and in it there is a marrow-like fluid.[d] In footed Vivipara there are cartilaginous parts at the ears and nostrils and some of the extremities of the bones.

IX Nail, hoof, etc.

Further, there are other kinds of parts whose substance is neither the same as those already mentioned nor far removed from it, *e.g.*, nail, hoofs, claws, and horns, and in addition to these the beak, as in birds—

[a] See Notes, § 3.

[b] *Cf. P.A.* 655 a 32.

[c] Regeneration of bone is in fact quite common, and occurs rapidly, in amphibia such as newts and salamanders.

[d] *Cf. P.A.* 652 a 13, 655 a 23, 37.

517 a

ὑπάρχει ταῦτα τὰ μόρια τῶν ζῴων. ταῦτα μὲν γὰρ καὶ καμπτὰ καὶ σχιστά, ὀστοῦν δ' οὐδὲν καμπτὸν οὐδὲ σχιστόν, ἀλλὰ θραυστόν.

Καὶ τὰ χρώματα τῶν κεράτων καὶ ὀνύχων καὶ χηλῆς καὶ ὁπλῆς κατὰ τὴν τοῦ δέρματος καὶ τὴν τῶν τριχῶν ἀκολουθεῖ χρόαν. τῶν τε γὰρ μελανοδερμάτων μέλανα τὰ κέρατα καὶ αἱ χηλαὶ καὶ αἱ ὁπλαί, ὅσα χηλὰς ἔχει, καὶ τῶν λευκῶν λευκά, μεταξὺ δὲ τὰ τῶν ἀνὰ μέσον. ἔχει δὲ καὶ περὶ τοὺς ὄνυχας τὸν αὐτὸν τρόπον. οἱ δ' ὀδόντες κατὰ τὴν τῶν ὀστῶν εἰσι φύσιν. διόπερ τῶν μελάνων ἀνθρώπων, ὥσπερ Αἰθιόπων καὶ τῶν τοιούτων, οἱ μὲν ὀδόντες λευκοὶ καὶ τὰ ὀστᾶ, οἱ δ' ὄνυχες μέλανες, ὥσπερ καὶ τὸ πᾶν δέρμα. τῶν δὲ κεράτων τὰ μὲν πλεῖστα κοῖλά ἐστιν ἀπὸ τῆς προσφύσεως περὶ τὸ ἐντὸς ἐκπεφυκὸς ἐκ τῆς κεφαλῆς ὀστοῦν, ἐπ' ἄκρου δ' ἔχει τὸ στερεόν, καί ἐστιν ἁπλᾶ· τὰ δὲ τῶν ἐλάφων μόνα δι' ὅλου στερεὰ καὶ πολυσχιδῆ. καὶ τῶν μὲν ἄλλων τῶν ἐχόντων κέρας οὐδὲν ἀποβάλλει τὰ κέρατα, ἔλαφος δὲ μόνος[1] καθ' ἕκαστον ἔτος, ἐὰν μὴ ἐκτμηθῇ· περὶ δὲ τῶν ἐκτετμημένων ἐν τοῖς ὕστερον λεχθήσεται. τὰ δὲ κέρατα προσπέφυκε μᾶλλον τῷ δέρματι ἢ τῷ ὀστῷ· διὸ καὶ ἐν Φρυγίᾳ εἰσὶ βόες καὶ ἄλλοθι οἳ κινοῦσι[2] τὰ κέρατα ὥσπερ τὰ ὦτα.

Τῶν δ' ἐχόντων ὄνυχας (ἔχει δ' ὄνυχας ἅπαντα ὅσαπερ δακτύλους, δακτύλους δ' ὅσα πόδας, πλὴν ἐλέφας· οὗτος δὲ καὶ δακτύλους ἀσχίστους καὶ ἠρέμα διηρθρωμένους καὶ ὄνυχας ὅλως οὐκ ἔχει) τῶν δ' ἐχόντων τὰ μέν ἐστιν εὐθυώνυχα, ὥσπερ

[1] μόνος AC : μόνον PD, vulg.
[2] οἳ κινοῦσι AC : κινοῦσαι PD, vulg.

in the several animals in which they occur. All these parts permit of bending and splitting ; bone permits of neither, but it can be broken.

Besides this, the colours of horns, nails, claws, and hoofs follow suit with the colour of the skin and hair : animals with black skin have black horns, claws, and hoofs (not all, of course, have claws), white-skinned animals have white ones, those with intermediate colours have ones to match. The same holds good for nails. The teeth, however, match the bones. Thus black men, like Ethiopians and such, have white teeth as well as white bones, but their nails, like the whole of their skin, are black. Most horns are hollow from the point where they are attached to the bone which projects inside them from the head, but at their tip there is a solid piece.[a] Their structure is simple. The stag is the only animal whose horns are solid throughout and branching. No other horned animal sheds its horns ; the stag is the only one which does this—every year, unless it has been castrated. (This subject will be dealt with later on.) Horns grow attached to the skin rather than to the bone. This explains why both in Phrygia and elsewhere cattle are found which can move their horns just as though they were ears.[b]

With reference to animals that possess nails—and all do possess them if they possess toes, and all have toes that have feet, except the elephant, which has toes that are not divided and faintly articulated, but no nails at all—of the animals that possess nails, then, some have straight ones (*e.g.*, man), others

[a] *Cf.* 500 a 6 ff., *P.A.* 663 b 15 ff., and add. n., p. 237.

[b] Thompson gives several references to ancient authors, and one dated 1661 relating to cattle in Madagascar.

517 b ἄνθρωπος, τὰ δὲ γαμψώνυχα, ὥσπερ καὶ τῶν πεζῶν λέων καὶ τῶν πτηνῶν ἀετός.

X Περὶ δὲ τριχῶν καὶ τῶν ἀνάλογον καὶ δέρματος τόνδ' ἔχει τὸν τρόπον.

Τρίχας μὲν ἔχει τῶν ζῴων ὅσα πεζὰ καὶ ζῳοτόκα, φολίδας δ' ὅσα πεζὰ καὶ ᾠοτόκα, λεπίδας δ' ἰχθύες μόνοι, ὅσοι ᾠοτοκοῦσι τὸ ψαθυρὸν ᾠόν· τῶν γὰρ μακρῶν γόγγρος μὲν οὐ τοιοῦτον ἔχει ᾠόν, οὐδ' ἡ μύραινα, ἔγχελυς δ' ὅλως οὐκ ἔχει.

Τὰ δὲ πάχη τῶν τριχῶν καὶ αἱ λεπτότητες καὶ τὰ μεγέθη διαφέρουσι κατὰ τοὺς τόπους, ἐν οἷς ἂν ὦσι τῶν μερῶν, καὶ ὁποῖον ἂν ᾖ τὸ δέρμα· ὡς γὰρ ἐπὶ τὸ πολὺ ἐν τοῖς παχυτέροις δέρμασι σκληρότεραι αἱ τρίχες καὶ παχύτεραι, πλείους δὲ καὶ μακρότεραι ἐν τοῖς κοιλοτέροις καὶ ὑγροτέροις, ἄνπερ ὁ τόπος ᾖ τοιοῦτος οἷος ἔχειν τρίχας. ὁμοίως δὲ καὶ περὶ τῶν λεπιδωτῶν ἔχει καὶ τῶν φολιδωτῶν. ὅσα μὲν οὖν μαλακὰς ἔχει τὰς τρίχας, εὐβοσίᾳ χρώμενα σκληροτέρας ἴσχει, ὅσα δὲ σκληράς, μαλακωτέρας καὶ ἐλάττους. διαφέρουσι δὲ καὶ κατὰ τοὺς τόπους τοὺς θερμοτέρους καὶ ψυχροτέρους, οἷον αἱ τῶν ἀνθρώπων τρίχες ἐν μὲν τοῖς θερμοῖς σκληραί, ἐν δὲ τοῖς ψυχροῖς μαλακαί. εἰσὶ δ' αἱ μὲν εὐθεῖαι μαλακαί, αἱ δὲ κεκαμμέναι σκληραί.

XI Ἡ δὲ φύσις τῆς τριχός ἐστι σχιστή. τῷ μᾶλλον δὲ καὶ ἧττον διαφέρουσι πρὸς ἀλλήλας. ἔνιαι δὲ τῇ σκληρότητι μεταβαίνουσαι κατὰ μικρὸν οὐκέτι

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[a] *Cf.* 510 b 26 above.

[b] For an account of the breeding habits of the eel see *G.A.*, Loeb ed., p. 565. To the references given there should be added: Léon Bertin, *Eels, a biological study* (London, 1956). A modification of Schmidt's explanation is pro-

crooked or curved ones (an example from walking animals is the lion, from flying ones, the eagle).

We now go on to describe hair and its counterparts, and skin. X Hair and skin.

All footed viviparous animals have hair ; footed Ovipara have horny scales ; fish alone have ordinary scales (*i.e.*, fishes which produce a crumbling egg [a] : there are, of course, long-bodied fishes such as the conger and the muraena which do not produce that type of egg ; and the eel [b] produces no egg at all).

Differences of thickness and length of hair are observed according to the different regions of the body where it occurs, and according to the character of the skin on which it grows. For the most part, the stouter the skin, the harder and stouter is the hair, and it is more plentiful and longer on the hollower and moister regions, provided the region is such as to permit the growth of hair. The case is similar with the animals that have fish-scales and horny scales. The hair of soft-haired animals becomes harder if they are well fed ; the hair of hard-haired ones becomes softer and less plentiful. Hair also differs according as the region of the body is warm or cold : thus in man the hair is hard in warm parts of the body and soft in cold ones. Furthermore, straight hair is soft, and curly hair hard.

Hair [c] is in its nature fissile : and it exhibits in different animals differences of " the more and less." [d] XI In some animals the hair gradually increases in hard-

pounded by Denys W. Tucker, " A new solution to the Atlantic eel problem," in *Nature*, 183 (1959), pp. 495-501 ; summary by Maurice Burton in *Ill. Lon. News*, 234 (1959), p. 532. See also *Nature*, 183, pp. 1405-1406.

[c] For a fuller discussion of hair see *G.A.* Book V, chh. 3-6.

[d] See Notes, § 3.

517 b θριξὶν ἐοίκασιν ἀλλ' ἀκάνθαις, οἷον αἱ τῶν ἐχίνων τῶν χερσαίων, παραπλησίως τοῖς ὄνυξιν· καὶ γὰρ τὸ τῶν ὀνύχων γένος ἐν ἐνίοις τῶν ζῴων οὐδὲν διαφέρει τὴν σκληρότητα τῶν ὀστῶν.

Δέρμα δὲ πάντων λεπτότατον ἄνθρωπος ἔχει κατὰ λόγον τοῦ μεγέθους. ἔνεστι δ' ἐν τοῖς δέρμασι πᾶσι γλισχρότης μυξώδης, ἐν μὲν τοῖς ἐλάττων ἐν δὲ τοῖς πλείων, οἷον ἐν τοῖς τῶν βοῶν, ἐξ ἧς ποιοῦσι τὴν κόλλαν· ἐνιαχοῦ δὲ καὶ ἐξ ἰχθύων ποιοῦσι κόλλαν.[1] ἀναίσθητον δὲ τὸ δέρμα τεμνόμενόν ἐστι καθ' αὑτό· μάλιστα δὲ τοιοῦτον τὸ ἐν τῇ κεφαλῇ, διὰ τὸ τὸ μεταξὺ ἀσαρκότατον εἶναι πρὸς τὸ ὀστοῦν. ὅπου
518 a δ' ἂν ᾖ καθ' αὑτὸ δέρμα, ἂν διακοπῇ, οὐ συμφύεται, οἷον γνάθου τὸ λεπτὸν καὶ ἀκροποσθία καὶ βλεφαρίς. τῶν συνεχῶν δ' ἐστὶ[2] τὸ δέρμα ἐν ἅπασι τοῖς ζῴοις, καὶ ταύτῃ διαλείπει ᾗ καὶ οἱ κατὰ φύσιν πόροι ἐξικμάζονται, καὶ κατὰ τὸ στόμα καὶ ὄνυχας.

Δέρμα μὲν οὖν ἅπαντα[3] ἔχει τὰ ἔναιμα ζῷα, τρίχας δ' οὐ πάντα, ἀλλ' ὥσπερ εἴρηται πρότερον. μεταβάλλουσι δὲ τὰς χρόας γηρασκόντων καὶ λευκαίνονται ἐν ἀνθρώπῳ· τοῖς δ' ἄλλοις γίγνεται μέν, οὐκ ἐπιδήλως δὲ σφόδρα, πλὴν ἐν ἵππῳ. λευκαίνεται δὲ καὶ ἀπ' ἄκρας ἡ θρίξ. αἱ δὲ πλεῖσται εὐθὺς φύονται λευκαὶ τῶν πολιῶν. ᾗ καὶ δῆλον ὅτι οὐχ αὐότης ἐστὶν ἡ πολιότης, ὥσπερ τινές φασιν· οὐδὲν γὰρ φύεται εὐθὺς αὖον.

Ἐν δὲ τῷ ἐξανθήματι ὃ καλεῖται λεύκη, πᾶσαι πολιαὶ γίγνονται· ἤδη δέ τισι κάμνουσι μὲν πολιαὶ ἐγένοντο, ὑγιασθεῖσι δὲ ἀπορρυεισῶν μέλαιναι ἀν-

[1] ἐνιαχοῦ . . . κόλλαν secl. A.-W., Dt.
[2] ἐστὶ AC : om. PD, vulg.
[3] ἅπαντα AC : πάντα vulg.

ness until it no longer resembles hair, but rather spines, as in the hedgehog ; and the same applies to nails : in some animals the nails are indistinguishable in hardness from bones.

With regard to skin : Man has, for his size, the finest skin of all animals. All varieties of skin contain a mucous sticky substance, some a lesser quantity, some a greater : an example of the latter is the hide of the ox, out of which glue is made. Glue is also made out of fishes in some places. The skin, in itself, has no sensation when cut : an extreme case of this is the skin on the head, because between it and the skull-bone there is an extreme absence of flesh. And wherever the skin is all on its own, it does not grow together again when severed, as is exemplified by the thin part of the jaw, the prepuce, and the eyelid. In all animals the skin belongs to that class of parts which are continuous, and is discontinuous only where the natural passages discharge their fluidity, and at the mouth and the nails.

Now all blooded animals have skin, but not all have hair : the facts are as already stated. The hair changes colour as animals age : in man it becomes white ; in other animals its colour certainly changes, but not very noticeably except in the horse. The whitening of the hair begins at the tip. But in most cases of greyness, the hairs are white at the start of their growth, which goes to show that greyness is not a sort of desiccation, as some allege, since nothing is desiccated at the very start of its growth.

In the eruptive disease called the white-sickness all the hairs go grey. Cases have been known where during the sickness the hairs became grey, but after recovery these hairs dropped out and black ones grew

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εφύησαν. [γίγνονταί τε μᾶλλον πολιαὶ σκεπαζομένων τῶν τριχῶν ἢ διαπνεομένων.][1] πρῶτον δὲ πολιοῦνται οἱ κρόταφοι τῶν ἀνθρώπων, καὶ τὰ πρόσθια πρότερα τῶν ὄπισθεν[2]· τελευταῖον δ' ἡ ἥβη.

Εἰσὶ δὲ τῶν τριχῶν αἱ μὲν συγγενεῖς, αἱ δ' ὕστερον κατὰ τὰς ἡλικίας γιγνόμεναι ἐν ἀνθρώπῳ μόνῳ τῶν ζῴων, συγγενεῖς μὲν αἱ ἐν τῇ κεφαλῇ καὶ ταῖς βλεφαρίσι καὶ ταῖς ὀφρύσιν, ὑστερογενεῖς δ' αἱ ἐπὶ τῆς ἥβης πρῶτον, ἔπειτα δ' αἱ ἐπὶ τῆς μασχάλης, τρίταὶ δ' αἱ ἐπὶ τοῦ γενείου· ἴσοι γὰρ οἱ τόποι εἰσὶν ἐν οἷς αἱ τρίχες ἐγγίγνονται αἵ τε συγγενεῖς καὶ αἱ ὑστερογενεῖς. λείπουσι δὲ καὶ ῥέουσι κατὰ τὴν ἡλικίαν αἱ ἐκ τῆς κεφαλῆς καὶ μάλιστα καὶ πρῶται. τούτων δ' αἱ ἔμπροσθεν μόναι· τὰ γὰρ ὄπισθεν οὐδεὶς γίγνεται φαλακρός. ἡ μὲν οὖν κατὰ κορυφὴν λειότης φαλακρότης καλεῖται. ἡ δὲ κατὰ τὰς ὀφρῦς ἀναφαλανθίασις· οὐδέτερον δὲ τούτων συμβαίνει οὐδενὶ πρὶν ἢ ἀφροδισιάζειν ἄρξηται. οὐ γίγνεται δ' οὔτε παῖς φαλακρὸς οὔτε γυνὴ οὔθ' οἱ ἐκτετμημένοι· ἀλλ' ἐὰν μὲν ἐκτμηθῇ πρὸ ἥβης, οὐ φύονται αἱ ὑστερογενεῖς, ἐὰν δ' ὕστερον, αὗται μόναι ἐκρέουσι, πλὴν τῆς ἥβης.

Γυνὴ δὲ τὰς ἐπὶ τῷ γενείῳ οὐ φύει τρίχας· πλὴν ἐνίαις γίγνονται ὀλίγαι, ὅταν τὰ καταμήνια στῇ, καὶ οἷον ἐν Καρίᾳ ταῖς ἱερείαις, ὃ δοκεῖ συμβαίνειν

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σημεῖον τῶν μελλόντων. αἱ δ' ἄλλαι γίγνονται μέν, ἐλάττους δέ. γίγνονται δὲ καὶ ἄνδρες καὶ γυναῖκες ἐκ γενετῆς ἐνδεεῖς τῶν ὑστερογενῶν τριχῶν· ⟨ὧν⟩[3] ἅμα καὶ ἄγονοι, ὅσοιπερ ἂν καὶ ἥβης στερηθῶσιν.

[1] secl. Dt.
[2] ὄπισθεν AC : ὀπισθίων PD, vulg.
[3] ⟨ὧν⟩ Dt.

in their place. [Hair tends to go grey more if it is kept covered than if it is freely exposed to the air.] The first hair to go grey in man is that on the temples ; and the forward parts are affected before the back parts. The last hair to go grey is the pubic hair.

Some hair is congenital, some grows later, according to the various stages of life—this applies to man only. The congenital hair is that on the head, on the eyelids, and the eyebrows ; the first of the later hair is the pubic, then that under the armpits, and third the hair on the chin. It will thus be seen that the number of places where the congenital hair grows and where the later hair grows are equal. It is the hair on the head which fails and falls out most of all as age advances, and it does so before any other. This applies only to the hair in front ; no one goes bald at the back of the head. Smoothness on the top of the head is called baldness, on the eyebrows *anaphalanthiasis*. Neither of these occurs in a man until he has entered upon sexual activity. No boy or woman or castrated man ever goes bald ; if castration takes place before puberty, the later growths of hair do not occur ; if after, the later growths only (except the pubic) fall away.

Women do not grow the hairs on the chin, except that in some cases a few hairs grow when menstruation ceases ; another example is the priestesses in Caria,[a] which when it occurs is considered a sign of events to come. The other later growths occur in women, but on a lesser scale. Cases occur of both men and women who from birth have been lacking in the later growths ; of these some are also impotent, *viz.*, those who are destitute of the pubic hairs.

[a] *Cf.* Herodotus i. 175, viii. 104.

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Αἱ μὲν οὖν ἄλλαι τρίχες αὐξάνονται κατὰ λόγον ἢ πλέον ἢ ἔλαττον, μάλιστα μὲν αἱ ἐν τῇ κεφαλῇ, εἶθ' αἱ ἐν[1] πώγωνι, καὶ εἰ[2] λεπτότριχοι, μάλιστα. δασύνονται δέ τισι καὶ αἱ ὀφρύες γιγνομένοις πρεσβυτέροις, οὕτως ὥστ' ἀποκείρεσθαι, διὰ τὸ ἐπὶ συμφύσει ὀστῶν κεῖσθαι, ἃ γηρασκόντων διιστάμενα διίησι πλείω ὑγρότητα. αἱ δ' ἐν ταῖς βλεφαρίσιν οὐκ αὐξάνονται, ῥέουσι δέ, ὅταν ἀφροδισιάζειν ἄρξωνται, καὶ μᾶλλον τοῖς μᾶλλον ἀφροδισιαστικοῖς. πολιοῦνται δὲ βραδύτατα αὗται.

Ἐκτιλλόμεναι δ' αἱ τρίχες μέχρι τῆς ἀκμῆς ἀναφύονται, εἶτα οὐκέτι. ἔχει δὲ πᾶσα θριξ ὑγρότητα πρὸς τῇ ῥίζῃ γλίσχραν, καὶ ἕλκει εὐθὺς ἐκτιλθεῖσα τὰ κοῦφα θιγγάνουσα. ὅσα δὲ ποικίλα τῶν ζῴων κατὰ τὰς τρίχας, τούτοις καὶ ἐν τῷ δέρματι προϋπάρχει ἡ ποικιλία καὶ ἐν τῷ τῆς γλώττης δέρματι. περὶ δὲ τὸ γένειον τοῖς μὲν συμβαίνει τὴν ὑπήνην καὶ τὸ γένειον δασὺ ἔχειν, τοῖς δὲ ταῦτα μὲν λεῖα τὰς σιαγόνας δὲ δασείας· ἧττον δὲ γίγνονται φαλακροὶ οἱ μαδιγένειοι. αὔξονται δ' αἱ τρίχες ἔν τε νόσοις τισίν, οἷον ἐν ταῖς φθίσεσι μᾶλλον, καὶ ἐν γήρᾳ καὶ τεθνεώτων, καὶ σκληρότεραι γίγνονται ἀντὶ μαλακῶν· τὰ δ' αὐτὰ ταῦτα συμβαίνει καὶ περὶ τοὺς ὄνυχας. ῥέουσι δὲ μᾶλλον αἱ τρίχες τοῖς ἀφροδισιαστικοῖς αἱ συγγενεῖς· αἱ δ' ὑστερογενεῖς γίγνονται θᾶττον. οἱ δ' ἰξίαν ἔχοντες ἧττον φαλακροῦνται, κἂν ὄντες φαλακροὶ λάβωσιν, ἔνιοι δασύνονται. οὐκ αὐξάνεται δὲ θριξ ἀποτμηθεῖσα, ἀλλὰ κάτωθεν ἀναφυομένη γίγνεται μείζων. καὶ αἱ λεπίδες δὲ τοῖς ἰχθύσι σκληρότεραι γίγνονται καὶ

[1] sic Dt. : εἶτα vulg.
[2] εἰ Pi. : οἱ vulg.

Hair of course grows in due proportion, whether more or less, wherever it is situated ; but it grows most on the head, next most on the chin ; and fine hair grows most of all. In some persons as they get older the eyebrows actually become thicker, and have to be cut ; the reason for this is that they are situated on a place where bones join, and as age advances these bones draw apart and allow more moisture to exude. The hairs in the eyelashes do not grow, but fall off, when sexual activity begins, and the more the greater this activity is. These hairs take the longest time to go grey.

Hairs plucked out before maturity, but not later, will grow again. Every hair has at its root a sticky fluid, and immediately after being plucked out it can raise light objects by touching them with it. Animals which exhibit diversity of colour in their hair have prior to that a diversity of colour in their skin and in the cuticle of the tongue. In some men the upper lip and the chin are well covered with hair ; in others these parts are smooth and the cheeks hairy. In addition, smooth-chinned men are less liable to go bald. In some diseases the hair tends to grow, *e.g.*, in cases of consumption, and in old age and after death, and its softness gives way to hardness. The same phenomena are exhibited by the nails. In those who are given to sexual activity the congenital hair falls sooner, and the later hair grows sooner. Those who suffer from varicose veins go bald less ; and sometimes if they are already bald when this malady overtakes them, their hair grows thicker. A hair which has been cut does not grow at the tip, but becomes longer by growing up from below. In fishes the scales become harder and thicker, and in those

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παχύτεραι, τοῖς δὲ λεπτυνομένοις καὶ τοῖς γηράσκουσι σκληρότεραι. καὶ τῶν τετραπόδων δὲ γιγνομένων πρεσβυτέρων τῶν μὲν αἱ τρίχες τῶν δὲ τὰ ἔρια βαθύτερα μὲν γίγνεται, ἐλάττω δὲ τῷ πλήθει· καὶ τῶν μὲν αἱ ὁπλαὶ τῶν δ' αἱ χηλαὶ γίγνονται γηρασκόντων μείζους, καὶ τὰ ῥύγχη τῶν ὀρνίθων. αὐξάνονται[1] δὲ καὶ αἱ χηλαί, ὥσπερ καὶ οἱ ὄνυχες.

XII Περὶ δὲ τὰ πτερωτὰ τῶν ζῴων, οἷον τοὺς ὄρνιθας,
519 a κατὰ μὲν τὰς ἡλικίας οὐδὲν μεταβάλλει, πλὴν γέρανος· αὕτη δ' οὖσα τεφρὰ μελάντερα γηράσκουσα τὰ πτερὰ ἴσχει· διὰ δὲ τὰ πάθη τὰ γιγνόμενα κατὰ τὰς ὥρας, οἷον ὅταν ψύχη γίγνηται μᾶλλον, ἔνια[2] γίγνεται τῶν μονοχρόων ἐκ μελάνων τε καὶ μελαντέρων λευκά, οἷον κόραξ τε καὶ στρουθὸς καὶ χελιδόνες· ἐκ δὲ τῶν λευκῶν γενῶν οὐκ ὦπται εἰς μέλαν μεταβάλλον. [καὶ κατὰ τὰς ὥρας δ' οἱ πολλοὶ τῶν ὀρνίθων μεταβάλλουσι τὰς χρόας, ὥστε λαθεῖν ἂν τὸν μὴ συνήθη.][3]

Μεταβάλλουσι δ' ἔνια τῶν ζῴων τὰς χρόας τῶν τριχῶν καὶ κατὰ τὰς τῶν ὑδάτων μεταβολάς· ἔνθα μὲν γὰρ λευκὰ γίγνονται, ἔνθα δὲ μέλανα ταὐτά. καὶ περὶ τὰς ὀχείας δ' ἐστὶν ὕδατα πολλαχοῦ τοιαῦτα, ἃ πιόντα καὶ ὀχεύσαντα μετὰ τὴν πόσιν τὰ πρόβατα μέλανας γεννῶσι τοὺς ἄρνας, οἷον καὶ ἐν τῇ Χαλκιδικῇ τῇ ἐπὶ τῆς Θρᾴκης ἐν τῇ Ἀσσυρίτιδι ἐποίει ὁ καλούμενος ποταμὸς Ψυχρός. καὶ ἐν τῇ Ἀντανδρίᾳ δὲ δύο ποταμοί εἰσιν, ὧν ὁ μὲν λευκὰ ὁ δὲ μέλανα ποιεῖ τὰ πρόβατα. δοκεῖ δὲ καὶ ὁ Σκάμανδρος ποταμὸς ξανθὰ τὰ πρόβατα ποιεῖν·

which are getting thin or old the scales become harder. In quadrupeds, as they grow old, the hair (or fleece as the case may be) becomes deeper, but the component hairs are fewer ; the hooves (or claws) grow larger, and birds' beaks do the same. The claws also grow, and so do the nails.

XII Changes of colour.

With regard to feathered animals, such as birds, none undergoes a change ⟨of colour⟩ through age except the crane, which begins as ashen-coloured and as it grows old its feathers get blacker. In addition, seasonal conditions, such as unusually sharp frost, cause some birds whose plumage is of a single colour to change. Thus, those with dark or darkish plumage turn white, *e.g.*, the raven, the sparrow, and the swallow, though no instance of a white bird changing to black has been observed. [Further, the majority of birds change their colour according to the seasons, so that anyone unfamiliar with them would not recognize them.]

Some animals change the colour of their hair even on account of a change in the water they drink. In some localities the same animal will be white, in another black. Also, with regard to mating, in some places the quality of the water is such that rams, if they drink it and then have intercourse, beget black lambs : this used to be caused by the river known as Coldstream (*Psychros*) in the district of Assyritis in the Chalcidian peninsula in Thrace. Also, in Antandria there are two rivers, one of which makes sheep white and the other black. It is also generally believed that the Scamander makes them yellow, and

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[1] AC : *αὔξονται* PD, vulg.
[2] *ἔνια* Sn. : *ἐνίοτε* vulg.
[3] secl. Dt.

519 a διὸ καὶ τὸν Ὅμηρόν φασιν ἀντὶ Σκαμάνδρου Ξάνθον προσαγορεύειν αὐτόν.

Τὰ μὲν οὖν ἄλλα ζῷα οὔτ' ἐντὸς ἔχει τρίχας, τῶν τ' ἀκρωτηρίων ἐν τοῖς πρανέσιν ἀλλ' οὐκ ἐν τοῖς ὑπτίοις· ὁ δὲ δασύπους μόνος καὶ ἐντὸς ἔχει τῶν γνάθων τρίχας καὶ ὑπὸ τοῖς ποσίν. ἔτι δὲ καὶ τὸ μυστακόκητος[1] ὀδόντας μὲν ἐν τῷ στόματι οὐκ ἔχει, τρίχας δ' ὁμοίας ὑείαις.

Αἱ μὲν οὖν τρίχες αὐξάνονται ἀποτμηθεῖσαι κάτωθεν, ἄνωθεν δ' οὔ· τὰ δὲ πτερὰ οὔτ' ἄνωθεν οὔτε κάτωθεν, ἀλλ' ἐκπίπτει. οὐκ ἀναφύεται δ' ἐκτιλθὲν οὔτε τῶν μελιττῶν τὸ πτερὸν οὔθ' ὅσα ἄλλ' ἔχει ἄσχιστον τὸ πτερόν· οὐδὲ τὸ κέντρον, ὅταν ἀποβάλλῃ ἡ μέλιττα, ἀλλ' ἔκτοτε ἀποθνήσκει.[2]

XIII Εἰσὶ δὲ καὶ ὑμένες ἐν τοῖς ζῴοις ἅπασι τοῖς ἐναίμοις. ὅμοιος δ' ἐστὶν ὁ ὑμὴν δέρματι πυκνῷ καὶ λεπτῷ, ἔστι δὲ τὸ γένος ἕτερον· οὔτε γάρ ἐστι σχιστὸν οὔτε τατόν. περὶ ἕκαστον δὲ τῶν ὀστῶν καὶ περὶ ἕκαστον τῶν σπλάγχνων ὑμήν[3] ἐστι καὶ ἐν τοῖς μείζοσι καὶ ἐν τοῖς ἐλάττοσι ζῴοις· ἀλλ' ἄδηλοι ἐν
519 b τοῖς ἐλάττοσι διὰ τὸ πάμπαν εἶναι λεπτοὶ καὶ μικροί. μέγιστοι δὲ τῶν ὑμένων εἰσὶν οἵ τε περὶ τὸν ἐγκέφαλον δύο, ὧν ὁ περὶ τὸ ὀστοῦν ἰσχυρότερος καὶ παχύτερος τοῦ περὶ τὸν ἐγκέφαλον, ἔπειθ' ὁ περὶ τὴν καρδίαν ὑμήν. διακοπεὶς δ' οὐ συμφύεται

[1] ita scripsi Th. secutus : μυστόκητος PAD : μυστοκῆτος C : ὁ μῦς τὸ κῆτος vulg.

[2] ἔκτοτε ἀποθνήσκει PD : θνήσκει AC, vulg.

[3] ὑμήν D : ὁ ὑμήν ACP, vulg.

this, they say, is why Homer [a] calls it the Yellow River (*Xanthos*) instead of Scamander.

All animals except one have no hair internally, and on their extremities the hair appears only on the upper surface, never on the lower. The exception is the hare (or " hairyfoot ") : this is the only animal which has hair both inside its mouth and on the underside of its feet. In addition, the moustache-whale [b] lacks teeth in its mouth, and has instead hairs similar to pigs' bristles.

Now hairs that have been cut grow at their base, though not at the tip ; whereas feathers do neither, but fall out. A bee's wing will not grow again if plucked out, nor will the wing of any other creature whose wings are undivided. Nor will a bee's sting grow again if the bee loses it ; from that time the bee begins to die.[c]

XIII
Membranes.

All blooded animals possess membranes. Now a membrane resembles a fine close-textured skin ; but it differs in character, because it admits neither of division nor of extension. Membrane surrounds every one of the bones and every one of the viscera both in the larger and in the smaller animals, though in the smaller ones they are difficult to detect owing to their excessive fineness and smallness. The largest membranes are those which surround the brain—two of them : the one round the bone is stronger and thicker than the one round the brain itself. Next largest is the membrane round the heart. If cut apart

[a] *Cf. Iliad* xx. 74 " Gods call it Xanthos, but men Scamander."

[b] Here, following Th.'s suggestion, I have restored " moustache-whale " for the manuscripts' (and later fabulous) " mouse-whale." See Th.'s note *ad loc.*, and *id.*, *Glossary of Greek Fishes*, p. 168.

[c] *Cf.* 626 a 17.

519 b

ψιλὸς ὑμήν, ψιλούμενά τε τὰ ὀστᾶ τῶν ὑμένων σφακελίζει.

XIV Ἔστι δὲ καὶ τὸ ἐπίπλοον ὑμήν. ἔχει δ' ἐπίπλοον ἅπαντα τὰ ἔναιμα· ἀλλὰ τοῖς μὲν πῖον τοῖς δ' ἀπίμελόν ἐστιν. ἔχει δὲ καὶ τὴν ἀρχὴν καὶ τὴν ἐξάρτησιν ἐν τοῖς ζῳοτόκοις καὶ ἀμφώδουσιν ἐκ μέσης τῆς κοιλίας, ᾗ ἐστιν οἷον ῥαφή τις αὐτῆς· καὶ τοῖς μὴ ἀμφώδουσι δ' ἐκ τῆς μεγάλης κοιλίας ὡσαύτως.

XV Ἔστι δὲ καὶ ἡ κύστις ὑμενοειδὴς μέν, ἄλλο δὲ γένος ὑμένος· ἔχει γὰρ τάσιν.[1] ἔχει δὲ κύστιν οὐ πάντα, ἀλλὰ τὰ μὲν ζῳοτόκα πάντα, τῶν δ' ᾠοτόκων ἡ χελώνη μόνον. διακοπεῖσα δ' οὐδ' ἡ κύστις συμφύεται ἀλλ' ἢ παρ' αὐτὴν τὴν ἀρχὴν τοῦ οὐρητῆρος, εἰ μή τι πάμπαν σπάνιον· γέγονε γάρ τι ἤδη τοιοῦτον. τεθνεώτων μὲν οὖν οὐδὲν διίησιν ὑγρόν, ἐν δὲ τοῖς ζῶσι καὶ ξηρὰς συστάσεις, ἐξ ὧν οἱ λίθοι γίγνονται τοῖς κάμνουσιν. ἐνίοις δ' ἤδη καὶ τοιαῦτα συνέστη ἐν τῇ κύστει ὥστε μηδὲν δοκεῖν διαφέρειν κογχυλίων.

Περὶ μὲν οὖν φλεβὸς καὶ νεύρου καὶ δέρματος, καὶ περὶ ἰνῶν καὶ ὑμένων, ἔτι δὲ καὶ περὶ τριχῶν καὶ ὀνύχων καὶ χηλῆς καὶ ὁπλῆς καὶ κεράτων καὶ ὀδόντων καὶ ῥύγχους καὶ χόνδρου καὶ ὀστῶν καὶ τῶν ἀνάλογον τούτοις τοῦτον ἔχει τὸν τρόπον.

XVI Σὰρξ δὲ καὶ τὸ παραπλησίαν ἔχον τὴν φύσιν τῇ σαρκὶ ἐν τοῖς ἐναίμοις ἐν[2] πᾶσίν ἐστι μεταξὺ τοῦ δέρματος καὶ τοῦ ὀστοῦ καὶ τῶν ἀνάλογον τοῖς ὀστοῖς· ὡς γὰρ ἡ ἄκανθα ἔχει πρὸς τὸ ὀστοῦν, οὕτω καὶ τὸ σαρκῶδες πρὸς τὰς σάρκας ἔχει τῶν ἐχόντων ὀστᾶ καὶ ἄκανθαν.

[1] ἔχει γὰρ τάσιν codd. : om. vulg.
[2] ἐν ACPD : om. vulg.

a bared membrane does not grow together again, and bones bared of their membranes mortify.

XIV The Omentum.

Another of the membranes is the Omentum. It is present in all blooded animals; and in some it is fatty, in others devoid of fat. In the viviparous animals which have teeth in both jaws its starting-point and its place of attachment is the middle of the stomach, where this has a sort of suture; in those which have not teeth in both jaws it begins at, and is attached to, the main stomach.

XV The Bladder.

The bladder, too, is membranous, but in a different way: the membrane here is extensible. Not all animals have a bladder: all Vivipara have one, but the tortoise is the only oviparous animal which has one. Like other membranes, the bladder if cut apart will not grow together again, unless the cut be made just by the beginning of the urethra, except very rarely; such growing together has been observed. In dead bodies the bladder passes no fluid, but in living ones it passes solid matter as well: this gives rise to stones in those who suffer in this way. In some persons objects have actually been formed in the bladder which are indistinguishable from cockle-shells.

We have now described blood-vessel, sinew, and skin; fibres and membrane; and further, hair, nail, claw, hoof, horn, teeth, beak, cartilage, bones, and their counterparts.

XVI Flesh.

We deal next with Flesh. Flesh, and that which has a similar nature to flesh as found in blooded animals, is in all instances placed between the skin and the bone (or the counterpart of bone): as fish-spine is to bone, so is the flesh-like substance to flesh—some animals have the one pair and some the other.

519 b

Ἔστι δὲ διαιρετὴ ἡ σὰρξ πάντῃ, καὶ οὐχ ὥσπερ τὰ νεῦρα καὶ αἱ φλέβες ἐπὶ μῆκος μόνον. λεπτυνομένων μὲν οὖν τῶν ζῴων ἀφανίζονται, καὶ γίγνονται φλέβια καὶ ἶνες· εὐβοσίᾳ δὲ πλείονι χρωμένων πιμελὴ ἀντὶ σαρκῶν. εἰσὶ δὲ τοῖς μὲν ἔχουσι τὰς σάρ-
520 a κας πολλὰς αἱ φλέβες ἐλάττους καὶ τὸ αἷμα ἐρυθρότερον καὶ[1] σπλάγχνα καὶ κοιλία μικρά· τοῖς δὲ τὰς φλέβας ἔχουσι μεγάλας καὶ τὸ αἷμα μελάντερον καὶ σπλάγχνα μεγάλα καὶ κοιλία μεγάλη, αἱ δὲ σάρκες
5 ἐλάττους. γίγνονται δὲ κατὰ σάρκα πίονα τὰ τὰς κοιλίας ἔχοντα μικράς.

XVII Πιμελὴ δὲ καὶ στέαρ διαφέρουσιν ἀλλήλων. τὸ μὲν γὰρ στέαρ ἐστὶ θραυστὸν πάντῃ καὶ πήγνυται ψυχόμενον, ἡ δὲ πιμελὴ χυτὸν καὶ ἄπηκτον· καὶ οἱ μὲν ζωμοὶ οἱ τῶν πιόνων οὐ πήγνυνται, οἷον ἵππου
10 καὶ ὑός, οἱ δὲ τῶν στέαρ ἐχόντων πήγνυνται, οἷον προβάτου καὶ αἰγός. διαφέρουσι δὲ καὶ τοῖς τόποις· ἡ μὲν γὰρ πιμελὴ γίγνεται μεταξὺ δέρματος καὶ σαρκός, στέαρ δ' οὐ γίγνεται ἀλλ' ἢ ἐπὶ τέλει τῶν σαρκῶν. γίγνεται δὲ καὶ τὸ ἐπίπλοον τοῖς μὲν πιμελώδεσι πιμελῶδες, τοῖς δὲ στεατώδεσι στεα-
15 τῶδες. ἔχει δὲ τὰ μὲν ἀμφώδοντα πιμελήν, τὰ δὲ μὴ ἀμφώδοντα στέαρ.

Τῶν δὲ σπλάγχνων τὸ ἧπαρ ἐν ἐνίοις τῶν ζῴων γίγνεται πιμελῶδες, οἷον τῶν ἰχθύων ἐν τοῖς σελάχεσιν· ποιοῦσι γὰρ ἔλαιον ἀπ' αὐτῶν, ὃ γίγνεται τηκομένων· αὐτὰ δὲ τὰ σελάχη ἐστὶν ἀπιμελώτατα
20 καὶ κατὰ σάρκα καὶ κατὰ κοιλίαν κεχωρισμένῃ πιμελῇ. ἔστι δὲ καὶ τὸ τῶν ἰχθύων στέαρ πιμελῶδες καὶ οὐ πήγνυται. πάντα δὲ τὰ ζῷα τὰ μὲν κατὰ σάρκα ἐστὶ πίονα τὰ δ' ἀφωρισμένως. ὅσα δὲ μὴ

[1] καὶ CPD : καὶ τὰ A, vulg.

Flesh can be divided in any direction, *i.e.*, not, like sinew and blood-vessel, lengthwise only. When animals become emaciated, the flesh disappears, and they become just blood-vessels and fibres ; when they are overfed, fat replaces flesh. In animals which are abundant in flesh, the blood-vessels are smaller and the blood redder, while the viscera and stomach are small ; in those that have large blood-vessels the blood is blacker, the viscera and the stomach large, and the flesh smaller in quantity. Animals that have small stomachs tend to become fat in their fleshy parts.

XVII Fat and Suet.

Fat and Suet. These differ from each other as follows : Suet is breakable in all directions and congeals when cooled, whereas fat can be melted but does not congeal. Soups made from fatty animals do not congeal, for example soup made from horse-flesh and pork, whereas those made from animals that contain suet do congeal, for example, mutton and goats' flesh. Also, fat and suet differ in that their place in the body is different : fat is formed between the skin and the flesh, suet only at the extreme of the fleshy parts. Again, in fatty animals the Omentum is fatty, and in animals that have suet it is suety. Also, animals with teeth in both jaws have fat, those without have suet.

The liver, one of the viscera, becomes fatty in some animals, as in the Selachia (to give an instance of a fish) : their livers when melted yield an oil. Otherwise these Selachia have no fat round either the flesh or the stomach—that is to say, they have no free fat. Furthermore, the suet in fish is fatty and does not congeal. All animals have fat, some with their flesh, some apart from it. Those whose fat is not free are

520 a

ἔχει κεχωρισμένην τὴν πιότητα, ἧττόν ἐστι πίονα κατὰ κοιλίαν καὶ ἐπίπλοον, οἷον ἔγχελυς· ὀλίγον γὰρ στέαρ ἔχουσι περὶ τὸ ἐπίπλοον. τὰ δὲ πλεῖστα γίγνεται πίονα κατὰ τὴν γαστέρα, καὶ μάλιστα τὰ μὴ ἐν κινήσει ὄντα τῶν ζῴων.

Οἱ δ' ἐγκέφαλοι τῶν μὲν πιμελωδῶν λιπαροί, οἷον ὑός, τῶν δὲ στεατωδῶν αὐχμηροί. τῶν δὲ σπλάγχνων περὶ τοὺς νεφροὺς μάλιστα πίονα γίγνεται τὰ ζῷα· ἔστι δ' ἀεὶ ὁ δεξιὸς ἀπιμελώτερος, κἂν σφόδρα πίονες ὦσιν, ἐλλείπει τι ἀεὶ κατὰ τὸ μέσον. περίνεφρα δὲ γίγνεται τὰ στεατώδη μᾶλλον, καὶ μάλιστα τῶν ζῴων πρόβατον· τοῦτο γὰρ ἀποθνήσκει τῶν νεφρῶν πάντῃ καλυφθέντων. γίγνεται

520 b δὲ περίνεφρα δι' εὐβοσίαν, οἷον τῆς Σικελίας περὶ Λεοντίνους· διὸ καὶ ἐξελαύνουσιν ὀψὲ τὰ πρόβατα τῆς ἡμέρας, ὅπως ἐλάττω λάβωσι τὴν τροφήν.

XVIII Πάντων δὲ τῶν ζῴων κοινόν ἐστι τὸ περὶ τὴν κόρην ἐν τοῖς ὀφθαλμοῖς ⟨πῖον⟩[1]· ἔχουσι γὰρ τοῦτο τὸ μόριον στεατῶδες πάντα ὅσα ἔχουσι τὸ τοιοῦτον μόριον ἐν τοῖς ὀφθαλμοῖς καὶ μή εἰσι σκληρόφθαλμα. ἔστι δ' ἀγονώτερα πάντα[2] τὰ πιμελώδη καὶ ἄρρενα καὶ θήλεα. πιαίνεται δὲ πάντα πρεσβύτερα μᾶλλον ἢ νεώτερα ὄντα, μάλιστα δ' ὅταν καὶ τὸ πλάτος καὶ τὸ μῆκος ἔχῃ τοῦ μεγέθους καὶ εἰς βάθος αὐξάνηται.

XIX Περὶ δ' αἵματος ὧδε ἔχει· τοῦτο γὰρ πᾶσιν ἀναγκαιότατον καὶ κοινότατον τοῖς ἐναίμοις καὶ οὐκ ἐπίκτητον, ἀλλ' ὑπάρχει πᾶσι τοῖς μὴ φθειρομένοις.

[1] ⟨πῖον⟩ Dt. (πῖον pro κοινόν A.-W.): *quod est prope pupillam oculi in omnibus animalibus est multi sepi* Σ.

[2] πάντα ACΣ: om. PD, vulg.

less fat than others with regard to their stomach and their Omentum : an example is the eel, which has very little fat round the Omentum. Most animals grow fat round the belly, and especially those animals which do not move about much.

In fatty animals the brain is oily (*e.g.*, the pig), in suety animals, it is devoid of oil.[a] The viscera in respect of which animals tend to grow fattest are the kidneys. The right kidney is always less fatty than the left ; and if both are very fat indeed, there is always a space clear of fat in between them. Animals that have suet tend to have it round the kidneys, and above all the sheep : sheep die through having their kidneys entirely enveloped in suet. Over-feeding brings on this condition, as occurs at Leontini in Sicily ; that is why they do not turn the sheep out to feed until late in the evening, to reduce the amount they eat.

XVIII A phenomenon common to all animals is fat [b] round the pupil of the eye : in all animals which have such a part in their eyes (provided these are not hard), it resembles suet. Fat animals, male and female alike, all tend to be poor breeders. Fatness occurs in older animals more than in young, and especially when they have reached their full breadth and length and are beginning to grow in depth.

XIX Blood. Now follows a description of the Blood. In all blooded animals this is the most indispensable and most universal part [c] ; it is not something acquired later, but it is present from the outset in all, provided they are not becoming corrupted. Blood is always

[a] Lit., " parched " ; *cf.* 522 a 25.

[b] πῖον (fat) is A.-W.'s and Dittmeyer's restoration. It is supported by Michael Scot's translation. *Cf.* 533 a 9.

[c] *Cf.* 511 b 11.

520 b

πᾶν δ' αἷμά ἐστιν ἐν ἀγγείῳ, ἐν ταῖς καλουμέναις φλεψίν, ἐν ἄλλῳ δ' οὐδενὶ πλὴν ἐν τῇ καρδίᾳ μόνον. οὐκ ἔχει δ' αἴσθησιν τὸ αἷμα ἁπτομένων ἐν οὐδενὶ τῶν ζῴων, ὥσπερ οὐδ' ἡ περίττωσις ἡ τῆς κοιλίας[1]· οὐδὲ δὴ ὁ ἐγκέφαλος οὐδ' ὁ μυελὸς οὐκ ἔχει αἴσθησιν ἁπτομένων. ὅπου δ' ἄν τις διέλῃ τὴν σάρκα, γίγνεται αἷμα ἐν ζῶντι, ἐὰν μὴ διεφθαρμένη ᾖ σὰρξ ᾖ.[2] ἔστι δὲ τὴν φύσιν τὸ αἷμα τόν τε χυμὸν ἔχον γλυκύν, ἐάν περ ὑγιὲς ᾖ, καὶ τὸ χρῶμα ἐρυθρόν· τὸ δὲ χεῖρον ἢ φύσει ἢ νόσῳ μελάντερον. καὶ οὔτε λίαν παχὺ οὔτε λίαν λεπτὸν τὸ βέλτιστον, ἐὰν μὴ χεῖρον ᾖ διὰ φύσιν ἢ διὰ νόσον. καὶ ἐν μὲν τῷ ζῴῳ ὑγρὸν καὶ θερμὸν ἀεί, ἐξιὸν δ' ἔξω πήγνυται πάντων πλὴν ἐλάφου καὶ προκὸς καὶ εἴ τι ἄλλο τοιαύτην ἔχει τὴν φύσιν· τὸ δ' ἄλλο αἷμα πήγνυται, ἐὰν μὴ ἐξαιρεθῶσιν αἱ ἶνες. τάχιστα δὲ πήγνυται τὸ τοῦ ταύρου αἷμα πάντων.

Ἔστι δὲ τῶν ἐναίμων ταῦτα πολυαιμότερα, ἃ[3] καὶ ἐν αὐτοῖς καὶ ἔξω ζῳοτοκεῖ,[4] τῶν ἐναίμων μὲν ᾠοτοκούντων δέ. τὰ δ' εὖ ἔχοντα ἢ φύσει ἢ τῷ ὑγιαίνειν οὔτε πολὺ λίαν ἔχει, ὥσπερ τὰ πεπωκότα πόμα πρόσφατον, οὔτ' ὀλίγον, ὥσπερ τὰ πίονα λίαν· τὰ γὰρ πίονα καθαρὸν μὲν ἔχει ὀλίγον δὲ τὸ αἷμα, καὶ γίγνεται πιότερα γιγνόμενα ἀναιμότερα· ἄναιμον γὰρ τὸ πῖον.

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Καὶ τὸ μὲν πῖον ἄσηπτον, τὸ δ' αἷμα καὶ τὰ ἔναιμα τάχιστα σήπεται, καὶ τούτων τὰ περὶ τὰ ὀστᾶ. ἔχει δὲ λεπτότατον μὲν αἷμα καὶ καθαρώτατον ἄνθρωπος, παχύτατον δὲ καὶ μελάντατον τῶν ζῳοτό-

[1] τῆς κοιλίας AC : ἐν τῇ κοιλίᾳ PD, vulg.
[2] ᾖ hic AC, post μὴ PD, vulg. [3] ἃ AC : τὰ PD, vulg.
[4] ζῳοτοκεῖ Rhen., Sn., Dt. : ζῳοτόκα [καὶ] vulg.

found in a container, *viz.*, in the blood-vessels, and nowhere else except only in the heart. In no animal is the blood susceptible of sensation when touched,[a] no more than the residue from the stomach is : the same is true of the brain and the marrow. If you sever the flesh at any place, blood appears, provided the animal is alive and the flesh is not gangrened. If healthy, blood naturally has a sweet taste, and a red colour ; if in inferior condition, either naturally or through disease, it tends to be black. Blood in its best condition is not excessively thick nor thin, unless it has deteriorated either naturally or through disease. In the living animal it is always fluid and warm, but once it has left the body the blood of all animals congeals—except that of the deer and the roe and other such animals. Otherwise blood always congeals, unless the fibres are taken out. The quickest of all to congeal is bull's blood.

Of blooded animals, those which are both internally and externally viviparous have more blood than the blooded Ovipara. In animals which are in good condition, either naturally or through healthy dieting,[b] the blood is neither unduly abundant (as it is in those which have taken a recent drink), nor scanty, as happens in excessively fat animals : in fat animals, of course, the blood is pure, but small in quantity ; and increase of fat and decrease of blood go together : a fat animal being deficient in blood.

Fat does not putrefy, whereas blood and parts containing blood putrefy rapidly, and of these especially the regions around the bones. Blood is finest and purest in man, thickest and blackest—among Vivi-

[a] *Cf. P.A.* 650 b 4 ff., where the reason is given.
[b] Lit., " in virtue of being healthy."

521 a

κων ταῦρος καὶ ὄνος. καὶ ἐν τοῖς κάτω δὲ μορίοις ἢ ἐν τοῖς ἄνω παχύτερον τὸ αἷμα γίγνεται καὶ μελάντερον.

Σφύζει δὲ τὸ αἷμα ἐν ταῖς φλεψὶν[1] ἅπασι πάντῃ ἅμα τοῖς ζῴοις, καὶ ἔστι τῶν ὑγρῶν μένον καθ' ἅπαν τε τὸ σῶμα τοῖς ζῴοις καὶ ἀεί, ἕως ἂν ζῇ, τὸ αἷμα μόνον. πρῶτον δὲ γίγνεται τὸ αἷμα ἐν τῇ καρδίᾳ τοῖς ζῴοις, καὶ πρὶν ὅλον διηρθρῶσθαι τὸ σῶμα. στερισκόμενα δ' αὐτοῦ καὶ ἀφιεμένου ἔξω πλείονος μὲν ἐκθνήσκουσι, πολλοῦ δ' ἄγαν ἀποθνήσκουσιν. ἐξυγραινομένου δὲ λίαν νοσοῦσιν· γίγνεται γὰρ ἰχωροειδές, καὶ διοροῦται οὕτως ὥστε ἤδη τινὲς ἴδισαν αἱματώδη ἱδρῶτα. καὶ ἐξιὸν ἐνίοις οὐ πήγνυται παντελῶς ἢ διωρισμένως καὶ χωρίς. τοῖς δὲ καθεύδουσιν ἐν τοῖς ἐκτὸς μέρεσιν ἔλαττον γίγνεται τὸ αἷμα, ὥστε καὶ κεντουμένων μὴ ῥεῖν ὁμοίως. γίγνεται δὲ πεττομένων[2] ἐξ ἰχῶρος μὲν αἷμα, ἐξ αἵματος δὲ πιμελή· νενοσηκότος δ' αἵματος αἱμορροΐς ἥ τ' ἐν ταῖς ῥισὶ καὶ ἡ περὶ τὴν ἕδραν, καὶ ἰξία. σηπόμενον δὲ γίγνεται τὸ αἷμα ἐν τῷ σώματι πύον, ἐκ δὲ τοῦ πύου πῶρος.

Τὸ δὲ τῶν θηλειῶν πρὸς τὸ τῶν ἀρρένων διαφέρει· παχύτερόν τε γὰρ καὶ μελάντερόν ἐστιν, ὁμοίως ἐχόντων πρὸς ὑγίειαν καὶ ἡλικίαν, ἐν τοῖς θήλεσιν, καὶ ἐπιπολῆς μὲν ἔλαττον ἐν τοῖς θήλεσιν, ἐντὸς δὲ πολυαιμότερα.[3] μάλιστα δὲ καὶ τῶν θηλέων ζῴων γυνὴ πολύαιμον, καὶ τὰ καλούμενα

[1] ἐν add. PD, vulg.
[2] sic PD : πεττόμενον AC, vulg.
[3] corr. Dt. : πολυαιμότερον codd., vulg.

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[a] *Cf. P.A.* 647 b 34. [b] See note on 489 a 23.

para—in the bull and the ass. In the lower parts of the body the blood is thicker and blacker than in the upper ones.[a]

The blood in animals pulsates in the blood-vessels all over the body at once ; and blood is the only fluid which remains throughout the whole body, and throughout life so long as it lasts. Further, blood is formed first in the heart, even before the body as a whole becomes articulated. If they are deprived of blood, or if a considerable quantity is lost, animals fall into a swoon : if too much is lost, they die. If it becomes too fluid, they fall ill, because then the blood becomes ichor-like,[b] and it gets so thin that cases have been known in which a blood-like sweat [c] has been observed. In some persons the blood, when it has left the body, does not congeal at all, or only in separate and isolated places. During sleep the blood becomes less plentiful in the exterior parts, so that if the sleeper is pricked with a sharp object the blood does not flow as copiously as usual. Blood is formed by a process of concoction out of ichor, and similarly fat out of blood. If the blood has become diseased haemorrhoids can be caused in the nostrils or the anus, or varicose veins may be produced. If the blood putrefies in the body it becomes pus, and pus produces *pōrus*.[d]

The blood of females differs from that of males. Thus, if both are on an equality with regard to health and age, the blood is thicker and blacker in females, and while it is less plentiful on the surface it is more plentiful inwardly. Further, of all female animals the human female has the most abundant blood, and

[c] *Cf. P.A.* 668 b 6, and note in Loeb ed. Perhaps a reference to a case of haematoporphyria.

[d] A kind of chalkstone.

521 a καταμήνια γίγνεται πλεῖστα τῶν ζῴων ταῖς γυναιξίν. νενοσηκὸς δὲ τοῦτο τὸ αἷμα καλεῖται ῥοῦς. τῶν δ' ἄλλων τῶν νοσηματικῶν ἧττον μετέχουσιν αἱ γυναῖκες. ὀλίγαις δὲ γίγνεται ἰξία καὶ αἱμορροΐς καὶ ἐκ ῥινῶν ῥύσις· ἐὰν δέ τι συμβαίνῃ τούτων, τὰ καταμήνια χείρω γίγνεται.

Διαφέρει δὲ καὶ κατὰ τὰς ἡλικίας πλήθει καὶ εἴδει τὸ αἷμα· ἐν μὲν γὰρ τοῖς πάμπαν νέοις ἰχωροειδές ἐστι καὶ πλέον, ἐν δὲ τοῖς γέρουσι παχὺ καὶ μέλαν καὶ ὀλίγον, ἐν ἀκμάζουσι δὲ μέσως· καὶ πήγνυται ταχὺ τὸ τῶν γερόντων, κἂν ἐν τῷ σώματι ἦ ἐπιπολῆς· τοῖς δὲ νέοις οὐ γίγνεται τοῦτο. ἰχὼρ δ' ἐστὶν ἄπεπτον αἷμα, ἢ τῷ μήπω πεπέφθαι ἢ τῷ διωρῶσθαι.

521 b

XX Περὶ δὲ μυελοῦ· καὶ γὰρ τοῦτο ἓν τῶν ὑγρῶν ἐνίοις τῶν ἐναίμων ὑπάρχει ζῴων. πάντα δ' ὅσα φύσει ὑπάρχει ὑγρὰ ἐν τῷ σώματι, ἐν ἀγγείοις ὑπάρχει, ὥσπερ καὶ αἷμα ἐν φλεψὶ καὶ μυελὸς ἐν ὀστοῖς, [τὰ δ' ἐν ὑμενώδεσι, καὶ δέρμασι καὶ κοιλίαις.][1] γίγνεται δ' ἐν μὲν τοῖς νέοις αἱματώδης πάμπαν ὁ μυελός, πρεσβυτέρων δὲ γενομένων ἐν μὲν τοῖς πιμελώδεσι πιμελώδης, ἐν δὲ τοῖς στεατώδεσι στεατώδης. οὐ πάντα δ' ἔχει τὰ ὀστᾶ μυελόν, ἀλλὰ τὰ κοῖλα, καὶ τούτων ἐνίοις οὐκ ἔνεστιν· τὰ γὰρ τοῦ λέοντος ὀστᾶ τὰ μὲν οὐκ ἔχει πάμπαν, τὰ δ' ἔχει μικρόν,[2] διόπερ ἔνιοι οὔ φασιν ὅλως ἔχειν μυελὸν τοὺς λέοντας, ὥσπερ εἴρηται καὶ[3] πρότερον. καὶ ἐν τοῖς ὑείοις δ' ὀστοῖς ἐλάττων ἐστίν, ἐνίοις δ' αὐτῶν πάμπαν οὐκ ἔνεστιν.

Ταῦτα μὲν οὖν τὰ ὑγρὰ σχεδὸν ἀεὶ σύμφυτά ἐστι

[1] secl. A.-W., Dt.

[2] sic AC : οὐκ ἔχει, τὰ δ' ἔχει πάμπαν μικρόν vulg.

the catamenia are more plentiful in women than in any other animal. This blood if it has become diseased is known as flux (*rhous*). Apart from this one, women are less troubled by maladies ⟨of the blood⟩. Few women suffer from varicose veins, haemorrhoids, or nose-bleeding ; and if any of these occurs, the catamenia deteriorate.

Blood differs both in quantity and in appearance according to age. In very young animals it is ichor-like and plentiful ; in the aged, thick, black, and scanty ; in the prime of life, it exhibits intermediate qualities. The blood of aged animals congeals quickly, even if it is at the surface of the body : this does not occur in the young. Ichor is simply unconcocted blood [a]—either because it has not yet been concocted, or because it has become thin again.

XX Marrow.

The next subject is Marrow. This is another of the fluid parts, which occurs in certain blooded animals. All natural fluids in the body are carried in receptacles ; thus, blood is carried in blood-vessels, and marrow in bones : [others are contained in membranous containers, whether in skin or gut]. In young animals the marrow is quite bloodlike ; when they are older, in the fatty animals it becomes fatty, and in the suety ones suety. Not all the bones contain marrow, but only the hollow ones, and some of these have none. Thus, in the lion some bones have no marrow at all, some only a little ; which explains why, as stated already, some writers assert that lions have no marrow.[b] In the bones of pigs there is a small quantity of marrow, though in some of them there is none at all.

Milk.

Now the fluids already mentioned are almost always

[a] See note on 489 a 23. [b] *Cf.* 516 b 7.

[3] καὶ om. D, vulg.

521 b τοῖς ζῴοις, ὑστερογενῆ δὲ γάλα τε καὶ γονή. τούτων δὲ τὸ μὲν ἀποκεκριμένον ἅπασιν, ὅταν ἐνῇ, ἐστίν,[1] τὸ γάλα· ἡ δὲ γονὴ οὐ πᾶσιν ἀλλ' ἐνίοις [οἱ καλούμενοι θοροί], οἷον[2] τοῖς ἰχθύσιν.

Ἔχει δ', ὅσα ἔχει τὸ γάλα, ἐν τοῖς μαστοῖς. μαστοὺς δ' ἔχει ὅσα ζῳοτοκεῖ καὶ ἐν αὑτοῖς καὶ ἔξω, οἷον ὅσα τε τρίχας ἔχει, ὥσπερ ἄνθρωπος καὶ ἵππος, καὶ τὰ κήτη, οἷον δελφὶς καὶ φώκαινα[3] καὶ φάλαινα· καὶ γὰρ ταῦτα μαστοὺς ἔχει καὶ γάλα. ὅσα δ' ἔξω ζῳοτοκεῖ μόνον ἢ ᾠοτοκεῖ, οὐκ ἔχει οὔτε μαστοὺς οὔτε γάλα, οἷον ἰχθὺς καὶ ὄρνις.

Πᾶν δὲ γάλα ἔχει ἰχῶρα ὑδατώδη, ὃς καλεῖται ὀρός, καὶ σωματῶδες, ὃ[4] καλεῖται τυρός· ἔχει δὲ πλείω τυρὸν τὸ παχύτερον τῶν γαλάκτων. τὸ μὲν οὖν τῶν μὴ ἀμφωδόντων γάλα πήγνυται (διὸ καὶ τυρεύεται τὸ[5] τῶν ἡμέρων), τῶν δ' ἀμφωδόντων οὐ πήγνυται, ὥσπερ οὐδ' ἡ πιμελή, καὶ ἔστι λεπτὸν καὶ γλυκύ. ἔστι δὲ λεπτότατον μὲν γάλα καμήλου, δεύτερον δ' ἵππου, τρίτον δ' ὄνου· παχύτατον δὲ τὸ βόειον. ὑπὸ μὲν οὖν τοῦ ψυχροῦ οὐ πήγνυται τὸ
522 a γάλα, ἀλλὰ διοροῦται μᾶλλον· ὑπὸ δὲ τοῦ πυρὸς πήγνυται καὶ παχύνεται. οὐ γίγνεται δὲ γάλα, πρὶν ἢ ἔγκυον γένηται, οὐδενὶ τῶν ζῴων ὡς ἐπὶ τὸ πολύ. ὅταν δ' ἔγκυον ᾖ, γίγνεται μέν, ἄχρηστον δὲ τὸ πρῶτον καὶ ὕστερον. μὴ ἐγκύοις δ' οὔσαις ὀλίγον μὲν ἀπ' ἐδεσμάτων τινῶν, οὐ μὴν ἀλλὰ καὶ βδαλλομέναις ἤδη πρεσβυτέραις προῆλθε, καὶ τοσ-

[1] ἐστίν AC : ἔνεστι PD, vulg.

[2] οἷον om. vulg. : ἐνίοις οἷον οἱ καλ. θ. ἐν ἰχθύσιν PD : οἱ καλ. θ. seclusi ut ex adnot. orta, om. Σ ; quid θοροί pluraliter scriptum significet non liquet.

[3] φώκαινα Karsch : φώκη codd., vulg. ἵππος καὶ φώκη, καὶ τὰ κήτη, οἷον δ. καὶ φάλαινα Meyer, p. 150.

connate in animals ; milk and semen, however, come to be formed later. Milk, whenever it is present, is in all cases present in an already secreted and separated state ; the semen, however, is not so produced in all animals, but only in some, as in fishes.[a]

As many animals as have milk have it in their breasts ; and breasts are present in all animals that are both internally and externally viviparous, *e.g.*, all animals that have hair, such as man and horse, and the Cetacea (such as the dolphin, the porpoise, and the whale) : these have breasts and milk. Those which are viviparous externally only, or which are oviparous, have neither breasts nor milk : examples are fishes and birds.

All milk contains a watery ichor known as whey, and a consistent stuff known as curd or cheese : the thicker sorts of milk contain more of the latter. Now the milk of the non-ambidentates curdles (hence the milk of the domesticated ones is made into cheese), but that of the ambidentates does not (nor indeed does their fat), and it is thin and sweet. The thinnest of all milk is the camel's, next the mare's, third the ass's ; cow's milk is the thickest. Cold does not cause milk to congeal, but rather to turn to whey ; heat makes it congeal and thicken. Generally speaking, milk is not produced in any animal until the time of pregnancy ; then it is produced, but the first milk is unfit for use, as also is the latest. In non-pregnant animals a small quantity of milk has been produced by the use of certain foods ; indeed, it has been known for quite elderly females to produce some

[a] *Cf. G.A.* 717 b 23 ff.

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[4] ὃς Dt., Sn. secutus.
[5] ⟨τὸ⟩ Richards.

522 a

οὗτον ἤδη τισὶν ὥστ' ἐκτιτθεῦσαι παιδίον. καὶ οἱ περὶ τὴν Οἴτην δέ, ὅσαι ἂν μὴ ὑπομένωσι τὴν ὀχείαν τῶν αἰγῶν, λαμβάνοντες κνίδην τρίβουσι τὰ οὔθατα βίᾳ διὰ τὸ ἀλγεινὸν εἶναι· τὸ μὲν οὖν πρῶτον αἱματῶδες ἀμέλγονται, εἶθ' ὑπόπυον, τὸ δὲ τελευταῖον γάλα ἤδη οὐδὲν ἔλαττον τῶν ὀχευομένων.

Τῶν δ' ἀρρένων ἔν τε τοῖς ἄλλοις ζῴοις καὶ ἐν ἀνθρώπῳ ἐν οὐδενὶ μὲν ὡς ἐπὶ τὸ πολὺ γίγνεται γάλα, ὅμως δὲ γίγνεται ἔν τισιν, ἐπεὶ καὶ ἐν Λήμνῳ αἶξ ἐκ τῶν μαστῶν, οὓς ἔχει δύο ὁ ἄρρην παρὰ τὸ αἰδοῖον, γάλα ἠμέλγετο τοσοῦτον ὥστε γίγνεσθαι τροφαλίδα, καὶ πάλιν ὀχεύσαντος τῷ ἐκ τούτου γενομένῳ συνέβαινε ταὐτόν. ἀλλὰ τὰ μὲν τοιαῦτα ὡς σημεῖα ὑπολαμβάνουσιν, ἐπεὶ καὶ τῷ ἐν Λήμνῳ ἀνεῖλεν ὁ θεὸς μαντευομένῳ ἐπίκτησιν ἔσεσθαι κτημάτων.[1] ἐν δὲ τοῖς ἀνδράσι μεθ' ἥβην ἐνίοις ἐκθλίβεται ὀλίγον· βδαλλομένοις δὲ καὶ πολὺ ἤδη τισὶ προῆλθεν.

Ὑπάρχει δ' ἐν τῷ γάλακτι λιπαρότης, ἣ καὶ ἐν τοῖς πεπηγόσι γίγνεται ἐλαιώδης. εἰς δὲ τὸ προβάτειον ἐν Σικελίᾳ, καὶ ὅπου πῖον,[2] αἴγειον μιγνύουσιν. πήγνυται δὲ μάλιστα οὐ μόνον τὸ τυρὸν ἔχον πλεῖστον, ἀλλὰ καὶ τὸ αὐχμηρότερον ἔχον.

Τὰ μὲν οὖν πλέον ἔχει γάλα ἢ ὅσον εἰς τὴν ἐκτροφὴν τῶν τέκνων, καὶ χρήσιμον εἰς τύρευσιν καὶ ἀπόθεσιν, μάλιστα μὲν τὸ προβάτειον καὶ τὸ αἴγειον, ἔπειτα τὸ βόειον· τὸ δ' ἵππειον καὶ ὄνειον

[1] μαντευσαμένῳ et χρημάτων PD, vulg.

[2] πῖον A^1C, Dt.: πλεῖον PDA^2, vulg.: *ubi coagulum caprinum miscent* Gul., unde ὀπὸν καὶ πυὸν αἴγειον coni. Th.

when milked, and some have produced sufficient to suckle a youngster. Furthermore, the inhabitants of the region round Mount Oeta take she-goats which refuse to submit to the male and rub their udders forcibly with nettles enough to cause pain ; the fluid they obtain to begin with is bloodlike, then it is mixed with pus, and finally it is true milk, no less than that which is obtained from those which submit to the male.

Generally speaking, milk is not produced in any male animals, man included, but it is in some individuals. For example, at one time there was in Lemnos a he-goat which used to be milked by its dugs (the male has two near the penis), and it produced so much that cheese was made out of it ; and the same occurred with a male of which it was the sire. Nevertheless, phenomena of this sort are regarded as signs from heaven. When the owner of the goat in Lemnos consulted the oracle, the god's reply was that he would come into possession of a fortune. There are men from whom, after reaching puberty, a small amount can be squeezed out ; some when milked have actually produced large quantities.

Milk contains a fatty ingredient, and in congealed milk this becomes oily. In Sicily, and wherever sheep's milk is fat, they mix goats' milk with it. The milk which congeals best is not only that which contains most cheese, but also that in which the cheese is less fatty.[a]

Now some animals produce more milk than is required to nourish their young, and this is useful for cheese-making and for storage. First in this respect is sheep's milk, next goats', then cows'. Mares' milk

[a] Lit., " parched " ; *cf.* 520 a 27.

522 a μίγνυται εἰς τὸν Φρύγιον τυρόν. ἔνεστι δὲ τυρὸς πλείων ἐν τῷ βοείῳ ἢ ἐν τῷ αἰγείῳ· γίγνεσθαι γάρ φασιν οἱ νομεῖς ἐκ μὲν ἀμφορέως αἰγείου γάλακτος τροφαλίδας ὀβολιαίας μιᾶς δεούσης εἴκοσιν, ἐκ δὲ βοείου τριάκοντα. τὰ δ' ὅσον τοῖς τέκνοις ἱκανόν, πλῆθος δ' οὐδὲν οὐδὲ[1] χρήσιμον εἰς τύρευσιν, οἷον 522 b πάντα τὰ πλείους ἔχοντα μαστοὺς δυοῖν· οὐδενὸς γὰρ τούτων οὔτε πλῆθός ἐστι γάλακτος οὔτε τυρεύεται τὸ γάλα.

Πήγνυσι δὲ τὸ γάλα ὀπός τε συκῆς καὶ πυετία. ὁ μὲν οὖν ὀπὸς εἰς ἔριον ἐξοπισθείς, ὅταν ἐκπλυθῇ πάλιν τὸ ἔριον εἰς γάλα ὀλίγον· τοῦτο γὰρ κεραννύμενον πήγνυσιν. ἡ δὲ πυετία γάλα ἐστίν· τῶν γὰρ XXI ἔτι θηλαζόντων γίγνεται ἐν τῇ κοιλίᾳ. ἔστιν οὖν[2] ἡ πυετία γάλα ἔχον ἐν ἑαυτῷ πῦρ ὃ ἐκ τῆς[3] τοῦ ζῴου θερμότητος πεττομένου τοῦ γάλακτος γίγνεται. ἔχει δὲ πυετίαν τὰ μὲν μηρυκάζοντα πάντα, τῶν δ' ἀμφωδόντων δασύπους. βελτίων δ' ἐστὶν ἡ πυετία ὅσῳ ἂν ᾖ παλαιοτέρα· συμφέρει γὰρ πρὸς τὰς διαρροίας ἡ τοιαύτη μάλιστα καὶ ἡ τοῦ δασύποδος· ἀρίστη δὲ πυετία[4] νεβροῦ.

Διαφέρει δὲ τῷ πλέον ἱμᾶσθαι γάλα ἢ ἔλαττον τῶν ἐχόντων γάλα ζῴων κατά τε τὰ μεγέθη τῶν σωμάτων καὶ τὰς τῶν ἐδεσμάτων διαφοράς, οἷον ἐν Φάσει μέν ἐστι βοΐδια μικρὰ ὧν ἕκαστον βδάλ-

[1] οὐδὲ Richards : οὔτε vulg.

[2] θ. ἐν τῇ κοιλίᾳ γίγνεται. ἔστιν οὖν A.-W. : θ. ἐστὶν ἐν τῇ κοιλίᾳ. γίγνεται οὖν vulg.

[3] sic PD : τυρόν· ἐκ δὲ τῆς C, A.-W., Dt.

[4] add. ἡ τοῦ PD, vulg.

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[a] See add. note, p. 239.

[b] Some MSS. and edd. here read τυρόν (cheese) ; see critical

and asses' milk is included in the blend for making Phrygian cheese. There is more cheese in cows' milk than in goats' : dairy-farmers tell us that out of one *amphoreus* of goats' milk they can get nineteen *obol*-cheeses,[a] and from the same amount of cows' milk, thirty. Other animals produce only enough milk to feed their young, and none over, none fit for cheese-making : this is true of all animals which have more than two dugs ; none of these animals produces a superabundance of milk nor is their milk made into cheese.

Milk is curdled by fig-juice aud rennet. The fig-juice is squeezed out into some wool, and then the wool is rinsed out into a small quantity of milk : this milk when mixed with other milk curdles it. Rennet XXI is a sort of milk ; it is formed in the stomach of young animals while still being suckled. Rennet is thus milk which contains fire,[b] which comes from the heat of the animal while the milk is undergoing concoction. All ruminants contain rennet ; the hare is the only ambidentate which does so. The older rennet is, the better it is : this sort is a very good remedy for looseness of the bowels ; so is hare's rennet, and young deer's rennet is the best of all.

The milk-producing animals yield a greater or less amount of milk in relation to their various sizes and the various pastures they feed on. Thus, in Phasis there is a breed of small cattle every one of which

note. *Cf. G.A.* 739 b 23 " Rennet is milk containing vital heat, which integrates the homogeneous substance and makes it set " (*εἰς ἓν ἄγει καὶ συνίστησι*) ; *cf.* 772 a 25. The action of rennet is compared with that of semen, though the " setting " brought about by the latter involves quality as well as quantity, whereas that brought about by rennet involves quantity only.

522 b

λεται γάλα πολύ, αἱ δ' Ἠπειρωτικαὶ βόες αἱ μεγάλαι βδάλλονται ἑκάστη ἀμφορέα καὶ τούτου τὸ ἥμισυ κατὰ τοὺς δύο μαστούς[1]· ὁ δὲ βδάλλων ὀρθὸς ἕστηκεν, μικρὸν ἐπικύπτων, διὰ τὸ μὴ δύνασθαι ἂν ἐφικνεῖσθαι[2] καθήμενος. γίγνεται δ' ἔξω ὄνου καὶ τἆλλα μεγάλα ἐν τῇ Ἠπείρῳ τετράποδα, μέγιστοι δ' οἱ βόες καὶ οἱ κύνες. νομῆς δὲ δέονται τὰ μεγάλα πλείονος· ἀλλ' ἔχει πολλὴν ἡ χώρα τοιαύτην εὐβοσίαν, καὶ καθ' ἑκάστην ὥραν ἐπιτηδείους τόπους. μέγιστοι δ' οἵ τε βόες εἰσὶ καὶ τὰ πρόβατα τὰ καλούμενα Πυρρικά, τὴν ἐπωνυμίαν ἔχοντα ταύτην ἀπὸ Πύρρου τοῦ βασιλέως.[3]

Τῆς δὲ τροφῆς ἡ μὲν σβέννυσι τὸ γάλα, οἷον ἡ Μηδικὴ πόα, καὶ μάλιστα τοῖς μηρυκάζουσιν· ποιεῖ δὲ πολὺ ἑτέρα,[4] οἷον κύτισος καὶ ὄροβοι, πλὴν κύτισος μὲν ὁ ἀνθῶν οὐ συμφέρει (πίμπρησι γάρ), οἱ δ' ὄροβοι ταῖς κυούσαις οὐ συμφέρουσι (τίκτουσι γὰρ χαλεπώτερον). ὅλως δὲ τὰ φαγεῖν ⟨πολὺ⟩[5] δυνάμενα τῶν τετραπόδων, ὥσπερ καὶ πρὸς τὴν κύησιν

[1] μαστεύσεις coni. Th.
[2] AC : ἐφικέσθαι PD, vulg.
[3] haec de Pyrrho rege suspic. Dittm. ; cf. 595 b 18, ubi πυρρίχας βοῦς codd. ; fortasse hic etiam πυρρίχα scribendum, et verba quae ad regem spectant delenda.
[4] ἑτέρα Dt. : ἕτερα APD, vulg.
[5] ⟨πολὺ⟩ Dt.

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[a] Large cows in Epeirus are mentioned again at 595 b 18 ff., where they are described as πυρρίχαι (not πυρρικαί) ; see note on l. 25 below.

[b] See add. note, p. 239.

[c] In this passage the only animals in Epeirus to which the adjective " Pyrrhic " is actually applied are the sheep, although the large cows in Epeirus are mentioned a few lines

yields a copious supply of milk. In Epeirus [a] there are large cows which yield an *amphoreus* [b] and half of this from the two teats. The milker has to stand upright, bending slightly forward, because he would not be able to reach far enough if seated. In addition to the cattle, all the quadrupeds (except the ass) in Epeirus are large in size, and in proportion the cattle and the dogs are the largest. Large animals of course require more extensive pasturage than small ones—which is supplied by this district : it provides just the rich feed which they need, and suitable regions for every season of the year. The cattle are very large indeed, and so are the Pyrrhic sheep as they are called (they are named after King Pyrrhus.) [c]

Some pasture, *e.g.*, lucerne,[d] causes a failure of milk, especially in ruminants ; other pasture increases the milk, *e.g.*, cytisus and vetches—though cytisus when in bloom is not wholesome, because it causes burning, and vetch is not wholesome for pregnant animals, because it makes parturition more difficult. Generally speaking, quadrupeds that can eat plentifully not only benefit in regard to pregnancy, but also

above, and at 595 b 18 ff. we find the large cows in Epeirus described as πυρρίχαι. It seems doubtful whether the explanation of the epithet given in the present passage can be genuine, since the famous King Pyrrhus of Epeirus was not born (*c.* 318 B.C.) until after Aristotle's death. Pyrrhus the son of Achilles, however, was said to have settled in Epeirus after the Trojan war and become the founder of the race of Molossian kings (*cf.* Pindar, *Nem.* iv. 82, vii. 54, etc., and Vergil, *Aen.* iii. 333). It seems possible that the name may be accounted for in this way. At Theocritus iv. 20 ὁ ταῦρος ὁ πυρρίχος occurs, where πυρρίχος is usually translated " ruddy " simply. I suspect that the original reading in the present passage was πυρρίχα (at 595 b 18 the MSS. give πυρρίχας), and that it was altered to suit the inserted explanation.

[d] Lit., " the Medic grass." *Medicago sativa* L.

522 b συμφέρει, καὶ βδάλλεται πολὺ τροφὴν ἔχοντα. ποιε, δὲ γάλα καὶ τῶν φυσ⟨κ⟩ωδῶν[1] ἔνια προσφερόμεναῖ οἷον καὶ κυάμων πλῆθος ὄἳ καὶ αἰγὶ καὶ βοἳ καὶ
523 a χιμαίρᾳ· ποιεῖ γὰρ καθιέναι τὸ οὖθαρ. σημεῖον δὲ τοῦ γάλα πλέον ἰμήσεσθαι,[2] ὅταν πρὸ τοῦ τόκου τὸ οὖθαρ βλέπῃ κάτω.

Γίγνεται δὲ πολὺν χρόνον γάλα πᾶσι τοῖς ἔχουσιν, ἂν ἀνόχευτα διατελῇ καὶ τὰ ἐπιτήδεια ἔχωσι, μά-
5 λιστα δὲ τῶν τετραπόδων πρόβατον· ἀμέλγεται γὰρ μῆνας ὀκτώ. ὅλως δὲ τὰ μηρυκάζοντα γάλα πολὺ καὶ χρήσιμον εἰς τυρείαν ἀμέλγεται. περὶ δὲ Τορώνην αἱ βόες ὀλίγας ἡμέρας πρὸ τοῦ τόκου διαλείπουσι, τὸν δ' ἄλλον χρόνον πάντα ἔχουσι γάλα. τῶν δὲ γυναικῶν τὸ πελιώτερον[3] γάλα βέλτιον τοῦ
10 λευκοῦ τοῖς τιτθευομένοις· καὶ αἱ μέλαιναι τῶν λευκῶν ὑγιεινότερον ἔχουσιν. τροφιμώτατον μὲν οὖν τὸ πλεῖστον ἔχον τυρόν, ὑγιεινότερον δὲ τοῖς παιδίοις τὸ ἐλάττονα.[4]

XXII Σπέρμα δὲ προἳενται πάντα τὰ ἔχοντα αἷμα. τί δὲ συμβάλλεται εἰς τὴν γένεσιν καὶ πῶς, ἐν ἄλλοις
15 λεχθήσεται. πλεῖστον δὲ κατὰ τὸ σῶμα ἄνθρωπος προἳεται. ἔστι δὲ τῶν μὲν ἐχόντων τρίχας γλίσχρον, τῶν δ' ἄλλων ζῴων οὐκ ἔχει γλισχρότητα.

[1] φυσκωδῶν scripsi : tale desideravit Th., cf. 595 b 6 : φυσωδῶν codd., edd. φασκωλοειδῶν coni. Warmington.

[2] ἰμήσεσθαι Buss., Pi., A.-W., Dt. : ἰμήσασθαι A^1C : γενήσεσθαι PDA^2, vulg.

[3] πελιώτερον A^1C : πελιδνότερον PDA^2, vulg.

[4] ἐλάττονα Sylb. : τὸ ἔχον ἐλάττονα Pi. : ἔλαττον codd., vulg.

[a] The mss. here read φυσωδῶν, "causing flatulence"; the same adjective occurs at 588 a 9; and at 595 b 6 the adjective φυσητικοῖς, where two mss. read φυσικοῖς. In the first

yield much milk because they are well nourished. Some of the podded [a] plants if used as feed are milk-producing ; a good diet of beans will do this for the ewe, the she-goat, the cow, and the young she-goat : it causes them to drop their udders. A sign that there will be a good yield of milk is when the udder faces downwards before parturition.

All milk-producing animals go on producing it for a long time if they are kept away from the male and are given suitable food : so far as quadrupeds are concerned this applies especially to the ewe, which can be milked for eight months continuously. Generally, the ruminants yield an abundance of milk, suitable for cheese-making. In the district round Toronē cows run dry for a few days before calving, but are in milk all the rest of the time. In women, milk which is rather livid in colour is better than white milk for suckling ; and dark women's milk is healthier than fair ones'. The most nourishing milk is that which contains most cheese, but milk containing less cheese is more healthy for children.

XXII Semen.

All blooded animals emit semen. We shall state elsewhere what is its contribution to generation, and the method of it. For his size, man emits more than any animal. The semen of hairy animals is sticky, but that of others is not. In all animals it is white.

and third of these passages the adjective is applied to beans and such plants. In his note on 595 b 6 Th. suggests that *φασήλοις*, or some word meaning " podded," is required ; and in the present passage he in fact translates by " leguminous." Following his suggestion I have conjectured *φυσκωδῶν*, from *φύσκη*, a large intestine, especially applied to one stuffed with meat to make a sausage or black pudding. *φύσκη* is also used by Dioscorides (*Alex.* 22) to denote the gall-bag on a plant ; it thus has some botanical connexion. The passage at Herodotus iv. 2 perhaps tells in favour of keeping *φυσωδῶν*.

523 a

λευκὸν δὲ πάντων· ἀλλ' Ἡρόδοτος διέψευσται γράψας τοὺς Αἰθίοπας προΐεσθαι μέλαιναν τὴν γονήν.

Τὸ δὲ σπέρμα ἐξέρχεται μὲν λευκὸν καὶ παχύ, ἂν ἧ ὑγιεινόν, θύραζε δ' ἐλθὸν λεπτὸν γίγνεται καὶ μέλαν. ἐν δὲ τοῖς πάγοις οὐ πήγνυται, ἀλλὰ γίγνεται πάμπαν λεπτὸν καὶ ὑδατῶδες καὶ τὸ χρῶμα καὶ τὸ πάχος· ὑπὸ δὲ τοῦ θερμοῦ πήγνυται καὶ παχύνεται. καὶ ὅταν ἐξίῃ χρονίσαν ἐν τῇ ὑστέρᾳ, παχύτερον ἐξέρχεται, ἐνίοτε δὲ ξηρὸν καὶ συνεστραμμένον. καὶ τὸ μὲν γόνιμον ἐν τῷ ὕδατι χωρεῖ κάτω, τὸ δ' ἄγονον διαχεῖται. ψευδὲς δ' ἐστὶ καὶ ὃ Κτησίας γέγραφε περὶ τῆς γονῆς τῶν ἐλεφάντων.

Herodotus [a] is mistaken when he writes that the Ethiopians emit black semen.

Semen when it issues from the body is white and thick, if it is healthy ; afterwards it becomes thin and black. In frosty weather it does not congeal but becomes quite thin and watery both in colour and consistency ; whereas heat makes it congeal and thicken. If it remains in the uterus a long time before coming out, it is thicker when it does so, and sometimes when it comes out it is dry and compact. Fertile semen sinks in water, infertile dissolves. Ktesias's statement [b] about the semen of elephants is untrue.

[a] Herodotus iii. 101 ; *cf. G.A.* 736 a 10.

[b] See *G.A.* 736 a 4 ff., and note there, in Loeb ed., on Ktesias.

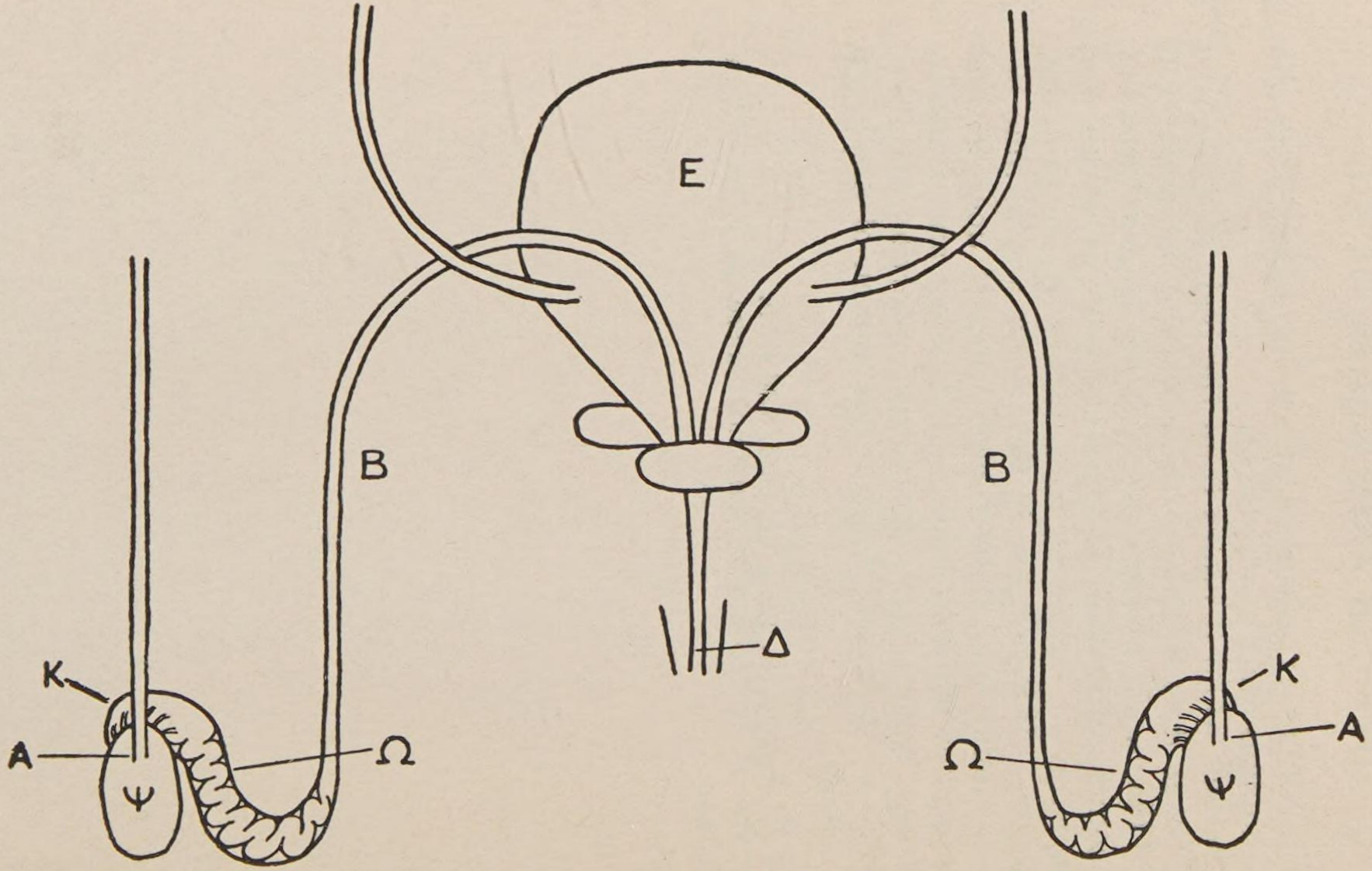

Diagram to illustrate Bk. III. 510 a 30-35

ADDITIONAL NOTES

Page 34, note *b*. See also *G.A.* 748 b 34, and note there in Loeb edition. P. Louis (*Revue de Philologie*, XXI (1957), pp. 63-65) argues that properly *ginnos* is simply a small ass or horse.

Page 88, note *a* (*cf.* page 84, note *a*). W. H. Riddell " Concerning Unicorns," *Antiquity*, XIX (1945), pp. 194 ff., records that he has seen oryx with only one horn as the result of fighting. The prototype of the unicorn he thinks may have been the nylghau (see 498 b 32). Wiegmann too (*ad loc.*), writing in 1826, quotes Prof. H. Lichtenstein as reporting oryx which had lost a horn : this he supposed had given rise to tales about the unicorn. Photius (*Bibl.* cod. 72, 48 b 19 ff. Bk.) quotes Ktesias as describing wild asses in India, equal in size to horses or larger, with a horn on their foreheads, a cubit in length, white at the base, red or purple at the tip, and black in the centre. Since Aristotle appears to be speaking of wild animals, artificially produced unicorns (*cf.* W. Franklin Dove, " Artificial production of the fabulous unicorn," *The Scientific Monthly*, XLII (1936), pp. 431-436) probably need not be taken into account. Nevertheless, Dr. Dove's operation on a male Ayrshire day-old calf confirms in a remarkable way Ktesias's description, as he himself points out (*loc. cit.*, p. 435) : " the horn sheath is white or greyish-white at the base, and is tipped with black. Had the unicorn been a female, the horn would be tipped with red, since the color appears as a sex-limited factor in this particular breed." (The animal at the time of writing was $2\frac{1}{2}$ years old). Cuvier had argued that a cloven-footed ruminant with a single horn would be impossible, because its frontal bone would be divided, and no horn could grow above the division. Dr. Dove's experiment showed (*J. of Experim. Zoology*, 69 (1935), pp. 347-405) that this argument was unfounded, since the horn spike grows not *from* the skull but *upon* the skull, first as an epiphysis, later to fuse to the frontal bones over the suture as a horn spike solidly attached to the skull ; a single united sheath covers the horn spike. The bony horn cores of ruminants are not outgrowths of the

skull (frontal) bones, as comparative anatomists (including Cuvier) had generally considered them to be, but are rather the products of separate ossification centres with their anlagen residing in tissues above the frontal bones ; and these anlagen or horn buds may be transplanted in whole or in part to other regions of the head, where they take root and develop as true horns or parts of horns either solidly or loosely attached to the skull, according to the method of transplantation. Dr. Dove also refers to a statement in Pliny (*N.H.* xi. 127), which indicates that the transplantation of horn-buds in young oxen to produce four-horned animals was practised in ancient times. (I am greatly indebted to my friend Mr. William F. Dove for sending me an offprint of his father's article in *The Scientific Monthly*, from which these excerpts are taken.) It is interesting to note that Aristotle seems to have known something of the way in which ruminants' horns grow, since at *H.A.* 500 a 8 he says that " the hollow part grows out rather from the skin," and at 517 a 27 that " the horns grow attached to the skin rather than to the bone," although in both passages he speaks of the central core as growing out of the bone of the skull. It may also be of interest to note that at *H.A.* 595 a 13 ff. Aristotle remarks that the horns of young cattle if smeared with hot wax can be turned in any direction one wishes.

Page 89, note *b*. Aristotle probably had in mind the half-astragal which appears in high relief as a ready means of identification on the top of the one-stater weights of Athens. For an example of a one-stater bronze weight of the fifth century found in the agora, see *Hesperia*, VII (1938), p. 360, fig. 51 ; fourth-century examples are similar. The labyrinth design is found on frescoes at Knossos, and on fourth-century coins of Knossos (see, *e.g.*, C. T. Seltman, *Greek Coins*, pl. xxxvii). For this information I am indebted to the kindness of Professor Homer A. Thompson.

Page 99, note *b*. The passage about the martichoras, however, appears in Michael Scot's translation. Photius' version (*Bibl.* cod. 72, 45 b 31 ff. Bk.) of Ktesias' account agrees closely with that given in the text of *H.A.*

Page 113, note *a*. Regenbogen thinks the account of the chamaeleon is probably taken from Theophrastus' treatise on animals that change their colour (see Photius, *Bibl.* cod.

278, 525 a 31 ff. Bk.). This, however, seems unlikely, since the present passage is concerned with much else beside colour-changes.

Page 228, note *a* (p. 230, n. *b*). An *amphoreus* for wine is usually taken as equal to about nine gallons, but many other sizes are known of jars so called. At Eurip. *Cyclops*, 327 the Cyclops tells Odysseus that he drinks off an *amphoreus* of milk, but deductions from this about the actual quantity might be unreliable. The obol here probably refers to price, since weight and shape both seem inappropriate. At *Odyssey*, ix. 246 ff. we read that the Cyclops, when he milked his animals, put half the milk into vessels for drinking later (as above), and the other half he curdled (*θρέψας*) and put into wicker baskets. Professor Homer Thompson tells me that we may have an indication of the kind of basket used for making cheeses, in a clay imitation of a small bowl-shaped basket, with almost straight sides, made by pressing clay into a finely-woven basket: the size of this vessel is $2\frac{3}{4}''$ high by nearly $4\frac{1}{2}''$ diameter at the rim (see Eva T. H. Brann, *The Athenian Agora* VIII, *Late Geometric and Protoattic Pottery*, 1962, p. 62, no. 271; illustrated on plate 16). Professor Thompson has also drawn my attention to the word *ὀβολιαῖος* or *ὀβελιαῖος* in Philo, *De Spec. Leg.* ii, § 20 (273 M.) used of loaves, with cheese in the context: *ὅμως ἐφ' ἃ καὶ οἱ πένητες ἡμεῖς ἔστιν ὅτε τρέπονται, κεραμιαίας κύλικας καὶ ὀβελιαίους ἄρτους καὶ ἐλαίας ἢ τυρὸν ἢ λάχανα προσόψημα*, where *ὀβελιαίους* is the reading of the oldest MS. (R), *ὀβολιαίους* of F; editors change it to *ὀβελίας* (*ὀβελέας* is the reading of M); the MSS. show similar variants for *κεραμιαίας*, which editors change to *κεραμεᾶς*. Colson here translates (reading *ὀβελίας*) "spit-baked loaves," and Cohn "geröstetes Brot." The word *ὀβελιαῖος*, in the sense of "sagittal," is used by Galen of the suture of a skull, and it has occurred to me that, since the bowl mentioned above has three bands of thin red glaze on the inside of the flat bottom, crossing at the centre, the baskets themselves might have had similar cross-bands, which would be impressed on the cheeses made in them, and this pattern could give rise to the description *ὀβολιαῖος*. The word *τροφαλίς* is no doubt connected with *τρέφω* (*cf.* *θρέψας* above).

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